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INDUSTRIAL-URBAN DEVELOPMENT AND AGRICULTURAL ADJUSTMENTS IN THE SOUTHERN PIEDMONT, 1940-50

ANTHONY M. TANG*
Vanderbilt University

I. *Introduction*

PERSISTENT community-wide poverty within agriculture is a well-known fact. Much less well-known are its causes. These have been variously attributed to such factors as the quality of farmland, the incidence of windfall gains or losses, the human agent's native productive capacity, community indifference patterns, and secular movements of farm commodity prices—all of which may differ greatly among communities. Professor Theodore W. Schultz, pursuing a new line of inquiry, dismissed these time-honored arguments, which may be characterized collectively as explanations based on "given" or "original" community differences. In their place, he advanced the hypothesis that persistent, indeed increasing, community differences in average farm income are to be explained by the dynamic, but uneven, pattern of economic development whose "locational matrices are primarily industrial-urban in composition."[1]

Underlying this hypothesis are the arguments: (1) That the factor and product markets are relatively more efficient within the effective confines of these matrices and relatively less efficient in peripheral areas. (2) That there are fundamental impediments to equilibrating factor movements which help perpetuate differences in market efficiency among areas.

* The writer wishes to express his appreciation to his colleagues, Professors William H. Nicholls and Frank T. Bachmura, for their very helpful comments. He is also very grateful to the Rockefeller Foundation for its grant in support of the larger project on Southern Economic Development of which this research is a part.

[1] "A Framework for Land Economics," *Journal of Farm Economics*, XXXIII, May 1951, pp. 205-6. The initial exposition of Professor Schultz's new line of inquiry may be found in his "Reflections on Poverty within Agriculture," *Journal of Political Economy*, LVIII, February 1950, pp. 1-15.

Under conditions of changing demand and technology, an area's farm income in the long run depends not so much on its current relative standing as on its relative ability to adapt its agriculture to changing conditions. This relative ability is a function of local market performance. Under this formulation, a working hypothesis may be stated as follows: Long-time, increasing disparity in agricultural income (per worker or per farm person) among areas is related to the pattern of local industrial-urban development whose positive income effect is transmitted to local agriculture through its impact upon local factor and product markets.

Several recent area studies undertaken at Vanderbilt University showed results surprisingly consistent with this hypothesis. At the same time, these studies indicated the apparent inability of "given" or "original" differences to sustain farm income differentials among areas over time. These findings pertain to the period 1850-1940. What of the more recent decade 1940-50? In view of its unprecedented prosperity and high war-induced resource mobility, this decade might well have been marked by an income equalization process in agriculture.

II. *Development Pattern and Farm Income, 1940-50*

The study area comprises twenty-one contiguous counties in the upper part of the Georgia and South Carolina Piedmont. The area is relatively homogeneous in terms of broad resource and population attributes, but highly differentiated internally by the rate of industrial-urban development since 1900. It is also one of the nation's agriculturally depressed areas. During the 1940's, the Southern Piedmont continued to experience important industrial-urban growth.[2] However, in line with its earlier pattern, the process of growth continued to be highly uneven. During 1939-47, increases in value added per capita ranged from $9 to $802 among the Piedmont counties. Thus, by 1947, two counties reported values added of less than $100 per capita, four from $100 to $200, and the remaining counties from $295 to $914.[3] Moreover, there has been no drastic shift in the relative standings of the area counties in that decade in terms of this index of industrial-urban development. The correlation coefficient between per capita value added of 1939 and that of 1947 was $+0.76^{*}$.[4] If a more adequate measure of industrial-urban development is used, the continued stability of the development pattern becomes even

[2] Textile with its heavy employment of women continues to be the dominant manufacturing industry.

[3] The primary source of these and other data used in this paper, unless otherwise indicated, is the decennial United States censuses.

[4] * indicates coefficients significant at the 5% level. Rank correlation coefficient (Spearman's rho) is used throughout this paper. Considering the crudeness of the data (often arrived at after numerous estimates and adjustments), the small number of counties, and the assumptions implicit in the parametric techniques, it is felt that this nonparametric method is less pretentious, if not also more appropriate, than

more striking. Thus, by substituting per capita payroll in major nonagricultural industries,[5] the relationship between the 1939 and 1947 values improved materially (rho = +0.87*).

These data clearly indicate a continued concentration of industrial-urban growth during the 1940's in the counties that already enjoyed greater development in 1940. These developed counties also reported significantly higher agricultural incomes and labor returns (gross or net) per farm worker in 1940.[6] Did the favorable conditions of the 1940's permit sufficient equilibrating factor movements that counteracted the expected income effect of this growth pattern upon the agriculture of the study area?

The answer appears to be in the negative. For 1940, the correlation between industrial-urban development and farm income per worker yields a coefficient of +0.42*. For 1950, the same relationship is indicated by a coefficient of +0.68*. This suggests that local industrial-urban growth had succeeded in exerting increasing influences upon the level of farm income of the area counties during 1940-50. That is to say, the disequilibrating income effect of an uneven industrial-urban development continued to outstrip the equilibrating effect of factor transfers so that as a determinant of farm income level this development gained in importance between 1940 and 1950. Also, the correlation between increases in farm income per worker[7] and increases in nonagricultural payroll per capita during the

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the orthodox variate correlation. In testing the significance of rho, E. G. Olds' table is used. This table is given in "The Five Per Cent Significance Levels for Sums of Squares of Rank Differences and A Correction," *Annals of Mathematical Statistics*, XX, 1949, pp. 117-18.

[5] A measure of this type is believed to be more adequate since, as Colin Clark has argued, a society's economic development, having reached an advanced stage in (secondary) industrial development, will largely take the form of growth in its tertiary industries. We have found that when value added by manufacture per capita is replaced by a more comprehensive measure (payroll in major nonagricultural industries per capita), the relationship between industrial-urban development and numerous other socio-economic variables is almost invariably improved. For this reason, industrial-urban development is measured by nonagricultural payroll per capita throughout the remainder of this paper.

[6] See my article, "Farm Income Differentials in the Southern Piedmont, 1860-1940," *Southern Economic Journal*, XXIII, July 1956, pp. 1-14.

[7] Farm income defined as the value of farm products sold or consumed on farms less most of the out-of-pocket production expenses (including estimated cost of fertilizer). Data do not represent net income, but they are superior to gross data in that county differences—which had become quite important during the 1940's as a result of substantial product innovations in some counties—in the relative importance of current production expenses are allowed for. Income excludes government payments to farmers but includes all income from agriculture paid to owners of factors outside of agriculture.

Farm workers defined to comprise the census farm (rural and urban) population aged 15 and over adjusted downward to allow for off-farm employment and school attendance and, in the case of females, also lower productivity and labor force participation.

TABLE 1. VALUE ADDED BY MANUFACTURE PER CAPITA, 1939 AND 1947; PAYROLL IN MAJOR NON-AGRICULTURAL INDUSTRIES PER CAPITA, 1939 AND 1947–48; FARM INCOME PER WORKER, 1939 AND 1949. SOUTHERN PIEDMONT

(County **Ranks in Parentheses**)

County	Value added by manufacture per capita[a]			Payroll in major nonagricultural industries per capita[b]			Farm income per worker[c]		
	1939	1947	Difference	1939	1947–48	Difference	1939	1949	Difference
Greenville	$183 (2)	$807 (2)	$624 (2)	$147 (1)	$597 (1)	$450 (1)	$269 (11½)	$1,174 (3)	$ 905 (2)
Spartanburg	181 (3)	789 (3)	608 (3)	127 (2)	545 (2)	418 (2)	369 (2)	1,192 (2)	823 (5)
Stephens	71 (14)	651 (6)	581 (6)	51 (14)	460 (3)	409 (3)	164 (21)	1,239 (1)	1,075 (1)
Lancaster	139 (5)	726 (4)	587 (4)	95 (5)	420 (4)	325 (4)	332 (4)	987 (12)	655 (14)
York	199 (1)	615 (7)	416 (8)	106 (3)	394 (5)	288 (6)	294 (8)	1,061 (7)	767 (7)
Union	112 (10)	914 (1)	802 (1)	98 (4)	391 (6)	293 (5)	224 (20)	884 (17)	660 (13)
Anderson	132 (6)	716 (5)	584 (5)	94 (6)	371 (7)	277 (7)	348 (3)	1,024 (9)	676 (10½)
Chester	120 (8)	482 (10)	362 (11)	93 (7)	363 (8)	270 (8½)	316 (7)	915 (15)	599 (17)
Hall	124 (7)	594 (8)	470 (7)	89 (8)	359 (9)	270 (8½)	247 (16)	1,149 (4)	902 (3)
Pickens	83 (12)	450 (11)	367 (10)	63 (11)	262 (10)	199 (10)	273 (10)	949 (14)	676 (10½)
Cherokee	119 (9)	509 (9)	390 (9)	78 (9½)	252 (11)	174 (12)	320 (5)	1,116 (5½)	796 (6)
Jackson	55 (16)	389 (13)	334 (12)	49 (15)	240 (12)	191 (11)	261 (14)	1,117 (5½)	856 (4)
Walton	75 (13)	310 (14)	235 (14)	53 (13)	219 (13)	166 (13½)	422 (1)	1,053 (8)	631 (16)
Oconee	57 (15)	390 (12)	333 (13)	43 (16)	209 (14)	166 (13½)	270 (11½)	1,008 (10½)	738 (8)
Barrow	158 (4)	296 (15)	138 (16)	78 (9½)	204 (15)	126 (15)	318 (6)	958 (13)	640 (15)
Elbert	87 (11)	179 (17)	92 (19)	58 (12)	169 (16)	111 (16)	245 (17)	821 (18)	576 (18)
Gwinnett	27 (17)	154 (18)	127 (17)	27 (17)	127 (17)	100 (17)	243 (18)	912 (16)	669 (12)
Franklin	9 (18)	187 (16)	178 (15)	12 (18)	100 (18)	88 (18)	263 (13)	756 (20)	493 (21)
Hart	8 (19)	109 (19)	101 (18)	11 (19)	70 (19)	59 (19)	282 (9)	1,010 (10½)	728 (9)
Banks	0 (20½)	28 (20)	28 (20)	1 (21)	21 (20)	20 (20)	235 (19)	736 (21)	501 (20)
Madison	0 (20½)	9 (21)	9 (21)	3 (20)	15 (21)	12 (21)	258 (15)	814 (19)	556 (19)
Weighted 21-County Av.	129	605	476	93	389	296	296[d]	1,023[d]	727[d]

[a] From U. S. censuses of manufacture of 1940 and 1947 and censuses of population of 1940 and 1950. Population counts for the year of 1947 were arrived at by straight-line interpolation using 1940 and 1950 census counts as terminal figures.

[b] Includes payrolls originating in the manufacturing, retail, wholesale, and services industries. From censuses of manufacture of 1940 and 1947 and censuses of business of 1940 and 1948.

[c] Income and worker as defined in text. Income, adjusted for yield variability, is net after costs of fertilizer, feed, fuel, and livestock purchased. For 1949, value of products consumed on farms is an estimate.

[d] Corresponding U. S. figures are $628, $1,957, and $1,329 respectively.

1940's yields a surprisingly high coefficient of +0.64*. Thus, the developed counties appear to have continued to move ahead of the underdeveloped counties in farm labor productivity in that decade.[8] To some this finding may come as a surprise since the decade was probably the most dynamic period in American history—a decade of high resource mobility and full employment that offered unprecedented alternatives to farm people in low-income farm areas. If such a decade had failed to bring about in these areas the necessary farm reorganization required to push their agricultural income to a level comparable to that in the other sectors or regions, one wonders whether under the existing market mechanism full-employment alone will solve the problems of depressed farm areas.

To gain insight into the reasons for the continued divergence in farm income within the study area, we now turn to an analysis of the nature of the resource and scale adjustments undertaken by the area's farm firms.

III. *Factor Adjustments, 1940-50*

The basic farm input and output data used in this paper were arrived at after numerous refinements and adjustments were applied to census returns. Certain items not enumerated by the Census Bureau, such as the value of farm-consumed farm products, the cost of fertilizer, and the

[8] Although the absolute dispersion (standard deviation) in income per farm worker rose (from $57 to $140) between 1940 and 1950, the relative dispersion as measured by the coefficient of variation narrowed (from 20% to 14%). This requires some elaboration. Take a simple case of two counties: A's 1940 and 1950 farm incomes were $200 and $400 per worker respectively and B's $400 and $700. Relatively, the difference has narrowed. Absolutely, it has not. The question as to which conclusion is more plausible depends on what one thinks future growth will be like. If one thinks that the base period relationship between A's rate of growth and B's will hold in the future, then a conclusion of convergence is appropriate. If one thinks that the base period relationship between A's absolute growth and B's will hold in the future, then a conclusion of convergence is misleading. In this case, the long-run income position of A can only approach (as a limit) two-thirds that of B. Even apart from this consideration, there is still one puzzling question unanswered. From a standpoint of either welfare or resource allocation, is an income difference between, say, $100 and $300 more significant than an income difference between $1,000 and $2,000?

A far more important consideration, however, has to do with the fact that we are thus far dealing with total farm income. No distinction is made between the commercial and part-time sectors of agriculture. As we shall see later, the sector defined as "part-time" (see footnote 12) was far more responsive than the commercial sector to the forces of local industrial-urban development. Thus, the developed counties reported far greater relative numbers of part-time farms than the underdeveloped counties. But for a number of reasons—some of which in no way imply lower efficiency—even relatively well-adjusted part-time farms yielded labor productivity below that of commercial farms of moderate size. This tends to pull down the developed counties' average *total* farm income per worker. Since part-time farming as a method of farm reorganization cuts across the agricultural and nonagricultural sectors, its effectiveness cannot be judged without the inclusion

* Income and value of products consumed on farms is an estimate. For 1949, value of products consumed on farms are $628, $1,957, and $1,329 respectively.
[a] Corresponding U. S. figures are

value of farm machinery and equipment in 1950, represent our estimates. Output data were further refined to eliminate the effect of short-run yield variability. These data thus represent essentially "normal" farm income. A simple test of reasonableness was then applied to the estimated input and output data, employing a multiple correlation in which changes in output during 1940-50 were related to changes in labor and capital[9] during the same period. Its result ($R = 0.85^{**}$) suggests that our basic data are adequate.

The test also brings to light two other significant pieces of information: (1) In real magnitudes, changes (reductions) in farm labor force were far more important during 1940-50 than changes (increases) in farm capital throughout the study area. (2) Yet, in terms of either the gross or partial correlation coefficients, changes in output were related primarily to changes in capital and, only to a limited extent, to changes in labor. This suggests the presence of substantial initial underemployment of farm labor in the study area, such that reductions in farm labor did not appreciably decrease output. This interpretation gains plausibility since the farm labor force, as defined in this paper, represents not so much labor input as available labor in agriculture.

These findings lead one to speculate that increased agricultural labor productivity during 1940-50 resulted primarily from adjustments in farm labor which served to reduce the labor denominator in the index of farm income per worker without at the same time reducing its income numerator appreciably. By relating percent increases in farm income per worker to percent decreases in farm labor and percent increases in capital respectively, we find that the speculation is consistent with the resulting correlation coefficients ($+0.44^{**}$ and -0.002 respectively).[10] Stated in differ-

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of both farm and nonfarm incomes. One solution to the problem is to add to total income from agriculture that income received by part-time farm families from off-farm employment. If the 1950 Census (net cash) median farm family income (available only for that year) is used to represent income so redefined, then the coefficient of variation increases to 28% (as compared with 14% if farm income alone is included). Since in 1940 off-farm employment of farm residents was relatively unimportant—only 10% of farm operator man-years was spent off-farm in 1940 as compared with 30% in 1950—it is doubtful that the coefficient of variation could be raised from 20% to 28% by the inclusion of income from off-farm employment. In short, the conclusion of increasing farm income disparity within the Southern Piedmont seems plausible for the decade 1940-50.

[9] Includes land, buildings, livestock, equipment, and current inputs.

[10] Computed from data in Table 2. In dealing with farm capital in the aggregate, have we concealed possible relationships between changes in labor productivity and changes in certain types of capital during 1940-50? No. The correlations between per cent increases in farm output per worker, on the one hand, and per cent increases in the total value of each of the principal capital components, on the other, yield the following nonsignificant coefficients: -0.05 for land and buildings, -0.08 for livestock, -0.06 for implements and machinery, -0.01 for current inputs, $+0.09$ for all non-current inputs, and -0.14 for all non-real-estate inputs.

ent words, these coefficients indicate that differential increases in farm income per worker among counties during 1940-50 resulted largely from their differential rates of adjustment in farm labor force rather than from those in farm capital. Considering the developed counties' more substantial declines in their farm labor force,[11] this then explains their continued success in pulling further ahead of the underdeveloped counties in terms of productivity of farm labor during the 1940's. Interestingly enough, there is apparently no correlation (rho = +0.12) between industrial-urban growth and relative increases in the total value of farm output during the 1940's. This indicates that the greater increases in labor productivity in the developed counties had been achieved without increasing their total output at a rate higher than that observed in the underdeveloped counties. This finding supports the argument that the solution of depressed farm areas' resource and income problems need not lead to increased national surpluses.

The relative importance of labor and capital adjustments as determinants of the area counties' relative level of productivity of agricultural labor can also be seen from the extent to which the ratio of capital to labor had been raised by changes in labor and by changes in capital. If percent increases in capital per worker are related to percent decreases in total labor, the resulting correlation coefficient is +0.85*. On the other hand, the correlation coefficient between percent increase in capital per worker and percent increases in total capital is only +0.22 (Table 2).

These findings need not mean that only labor markets were more efficient in the developed counties. One can readily assert differential efficiency in capital markets, if the developed counties' markets permitted their farmers to narrow the gap between rates of returns to capital and interest rates more substantially than might be expected in the underdeveloped counties. That the gap had been narrowed more rapidly in the developed counties can be inferred indirectly from the high correlation (+0.71*) between industrial-urban growth and increases in capital per worker during the 1940's.

Significantly, the developed counties showed more substantial adjustments in their agricultural sector despite important equilibrating population movements during the 1940's. During the decade, the study area lost 37,473 Negroes or 18.7 per cent of its original 1940 Negro population through net outmigration (Table 3). Among counties, the rates of net migration varied greatly, ranging from +0.6 per cent in Hall County to −51.4 per cent in Banks County. The correlation coefficient (+0.62*) between industrial-urban growth and the rate of net inmigration, 1940-50, clearly shows that net Negro outmigration had been more important in

[11] Correlation between decreases in farm labor and increases in nonagricultural payroll per capita yields a coefficient +0.61*.

TABLE 2. CHANGES IN FARM INCOME AND CAPITAL PER WORKER, 1940-50 AND TOTAL FARM INCOME, CAPITAL, AND LABOR IN 1940 AND 1950, SOUTHERN PIEDMONT[a]

(Ranks in parentheses)

County	% changes in *per worker*		Total farm income[b]		Total farm capital[be]		Total farm labor	
	Farm income 1939–49	All capital[c] 1940–50	1939	1949	1940	1950	1939	1949
Anderson, S. C.	194 (18)	278 (11)	$ 4,031	$ 7,718	$ 20,853	$ 51,318	11,589	7,539
Cherokee	249 (10½)	272 (12)	1,565	3,979	7,215	19,532	4,895	3,566
Chester	190 (19)	201 (19)	1,467	2,980	6,967	14,669	4,648	3,256
Greenville	336 (3)	303 (6½)	2,574	6,275	20,101	45,174	9,577	5,343
Lancaster	197 (17)	281 (10)	1,462	2,450	6,544	14,078	4,399	2,482
Oconee	273 (7)	286 (8½)	1,813	3,610	8,514	17,510	6,727	3,580
Pickens	248 (10½)	376 (4)	1,541	2,819	9,339	23,381	5,646	2,970
Spartanburg	223 (13)	261 (13)	4,324	10,077	22,620	58,891	11,717	8,452
Union	295 (5)	303 (6½)	824	1,871	4,515	10,456	3,682	2,117
York	261 (8)	234 (15)	2,006	5,396	12,153	30,251	6,825	5,085
Banks, Ga.	213 (14½)	286 (8½)	539	1,055	2,458	5,944	2,289	1,434
Barrow	201 (16)	180 (21)	803	1,946	4,079	9,190	2,523	2,032
Elbert	235 (12)	339 (5)	924	1,857	4,022	10,589	3,776	2,263
Franklin	187 (20)	256 (14)	1,002	1,980	4,850	11,890	3,811	2,620
Gwinnett	275 (6)	402 (3)	1,394	2,887	6,828	18,892	5,743	3,166
Hall	365 (2)	462 (2)	1,074	3,301	4,849	18,000	4,352	2,873
Hart	258 (9)	219 (17)	1,260	3,319	5,383	12,629	4,465	3,284
Jackson	328 (4)	226 (16)	1,086	3,329	5,341	12,463	4,162	2,981
Madison	215 (14½)	191 (20)	946	2,347	4,350	9,955	3,672	2,884
Stephens	655 (1)	520 (1)	319	855	2,033	4,479	1,941	690
Walton	149 (21)	211 (18)	1,754	3,839	6,352	17,297	4,156	3,645
All Counties	246	276	$32,708	$73,890	$169,366	$416,588	110,595	72,262
U.S.	204	170	5,870	16,617	43,198	108,607	9,343[d]	8,490[d]

[a] Because of space limitation see my forthcoming monograph on Southern Piedmont for details on definitions, sources, and methods of estimating basic data.
[b] In thousands of dollars. For the U.S., figures are millions of dollars.
[c] Includes value of land and buildings, livestock, implements and machinery, and current inputs (fertilizer, feed, fuel, and livestock purchased). The writer realizes that the aggregation of flow and inventory capital items probably does violence to one's sense of propriety.
[d] In thousands of workers.

those counties with slower industrial-urban growth. A similar relationship (rho = +0.76*) was observed with respect to White migration, although this had been much less important. For the study area, this totaled 16,478 or 2.7 per cent of its 1940 White population. In terms of total (White and Negro) net migration, the net loss for the area came to 53,951 persons over the 10-year period or 6.6 per cent of its total 1940 population. Among the area counties, only four netted some inmigration (0.6-5.6 per cent), while all others suffered net losses from 1.9 to 35.1 per cent. The relationship between industrial-urban growth and total net inmigration rates is also positive and highly significant (rho = +0.73*).

Thus, while population movements responded to county (and regional) differences in employment opportunities and income levels, these movements were not sufficient to prevent further divergences in agricultural labor productivity between the developed and underdeveloped counties. In view of the greater declines in the developed counties' farm labor force, these transfers failed even to offset county differentials in alternative employment opportunities open to farm people. Policywise, this

TABLE 3. ESTIMATED NET IN-MIGRATION (+) AND OUT-MIGRATION (−) BY RACE APRIL 1, 1940 TO APRIL 1, 1950, SOUTHERN PIEDMONT[a]

(County Ranks in Parentheses)

County	Net migration, *total population*, 1940–50		Net migration, *White population*, 1940–50		Net migration, *Negro population*, 1940–50	
	Absolute	Relative (1940 Pop. = 100)	Absolute	Relative (1940 Pop. = 100)	Absolute	Relative (1940 Pop. = 100)
		Per Cent		Per Cent		Per Cent
Anderson, S. C.	−11,893	−13.4 (12)	− 5,050	− 7.7 (10)	− 6,843	−29.3 (16)
Cherokee	− 4,043	−12.1 (10)	− 2,698	−10.6 (15)	− 1,345	−17.3 (6)
Chester	− 5,160	−15.8 (14)	− 786	− 4.6 (8)	− 4,374	−28.0 (15)
Greenville	+ 7,640	+ 5.6 (1)	+10,610	+10.0 (2)	− 2,970	− 9.8 (4)
Lancaster	− 2,900	− 8.6 (7)	− 347	− 2.0 (6)	− 2,463	−21.6 (8)
Oconee	− 3,724	−10.2 (9)	− 2,256	− 7.3 (9)	− 1,468	−25.4 (14)
Pickens	− 3,644	− 9.8 (8)	− 2,547	− 7.9 (11)	− 1,097	−22.4 (9)
Spartanburg	+ 792	+ 0.6 (4)	+ 2,277	+ 2.3 (4)	− 1,485	− 4.9 (3)
Union	− 4,633	−14.8 (13)	− 1,827	− 9.1 (13)	− 2,806	−24.9 (12)
York	+ 1,539	+ 2.6 (3)	+ 4,587	+12.3 (1)	− 3,048	−14.2 (5)
Banks, Ga.	− 3,067	−35.1 (21)	− 2,727	−33.8 (21)	− 340	−51.4 (21)
Barrow	− 1,653	−12.7 (11)	− 1,086	−10.2 (14)	− 567	−23.1 (11)
Elbert	− 3,758	−19.2 (16)	− 1,067	− 9.0 (12)	− 2,691	−34.8 (20)
Franklin	− 3,557	−22.8 (18)	− 2,796	−21.0 (18)	− 761	−33.5 (18½)
Gwinnett	− 944	− 3.2 (6)	− 254	− 1.0 (5)	− 690	−20.7 (7)
Hall	− 676	− 1.9 (5)	− 697	− 2.2 (7)	+ 21	+ 0.6 (1)
Hart	− 3,145	−20.3 (17)	− 2,245	−19.4 (17)	− 900	−22.7 (10)
Jackson	− 4,737	−23.6 (19½)	− 3,551	−21.5 (19)	− 1,186	−33.5 (18½)
Madison	− 3,165	−23.6 (19½)	− 2,370	−21.9 (20)	− 795	−30.5 (17)
Stephens	+ 449	+ 3.5 (2)	+ 464	+ 4.2 (3)	− 15	− 0.8 (2)
Walton	− 3,672	−17.7 (15)	− 2,022	−14.3 (16)	− 1,650	−25.0 (13)
All 21 Counties	−53,951	− 6.6[b]	−16,478	− 2.7[b]	−37,473	−18.7[b]

[a] Computed from population counts in decennial population censuses of 1940 and 1950 and from birth and death statistics in annual vital statistics reports (*Vital Statistics of the United States*, Department of Health, Education, and Welfare, 1940–50). Net migration estimates are arrived at (1) by estimating the expected population on April 1, 1950 in the absence of migration and (2) by taking the difference between the expected population and the actual census population on the same date. This difference indicates net in- or out-migration depending on whether the census population exceeds or falls short of the expected population. The expected population is calculated on the basis of the following formula: $P_{50} = P_{40} + B - D$, where P_{50} is the expected 1950 population in the absence of migration during 1940–50, P_{40} the census 1940 population, B the total number of live births during 1940–50 (by place of residence), and D the total number of deaths during 1940–50 (by place of residence).

[b] Corresponding unweighted means are −12.0%, −8.3%, and −22.5% respectively.

seems to suggest that, under the framework of existing markets and development pattern, it would be ill-advised to rely solely on full-employment policies in solving the low-income problem.

IV. *Effects of Industrial-Urban Development Upon Commercial and Part-time Farms*

We now turn our attention to an investigation of the manner and degree with which the commercial and part-time[12] sectors of agriculture responded to differential industrial-urban development within the study area during 1940-50. Because of the lack of a comparable breakdown by commercial and part-time farms in the 1940 census, we shall rely upon cross-sectional analyses for the year 1949-50. In that year there was a

[12] Actually, the part-time sector in this paper refers to what the Census Bureau called "other" farms which include part-time as well as residential and abnormal farms. Part-time farms include those farms selling between $250 and $1,199 of farm products per year where (a) the farm operator worked off farm 100 days or

TABLE 4. INCOME PER WORKER AND INDEX OF CAPITAL PER WORKER COMMERCIAL AND PART-TIME FARMS, 1949–50, SOUTHERN PIEDMONT

(Ranks in Parentheses)

County	Farm income per worker, 1949[a]				Index of farm capital per worker, 1950[b]	
	All farms	Commercial (A)	Part-time (B)	B as % of A	Commercial	Part-time
Anderson	$ 923 (10)	$ 980 (11½)	$ 682 (11)	70 (8)	23 (5)	20 (5)
Cherokee	1,025 (6)	1,026 (9)	1,017 (2)	99 (1½)	37 (13)	21 (6½)
Chester	834 (16)	920 (14)	461 (16)	50 (14)	34 (11)	29 (11)
Greenville	1,071 (4)	1,074 (6)	1,066 (1)	99 (1½)	30 (9)	11 (3)
Lancaster	899 (12)	930 (13)	797 (5½)	86 (4)	51.5 (20)	8 (2)
Oconee	950 (9)	1,219 (3)	670 (12)	55 (13)	36.5 (13)	43.5 (14)
Pickens	858 (14)	906 (16)	798 (5½)	88 (3)	24 (6)	23 (8)
Spartanburg	1,089 (3)	1,213 (4)	716 (9)	59 (10)	36 (13)	18.5 (4)
Union	819 (17)	861 (19)	684 (10)	79 (7)	41.5 (17)	21.5 (6½)
York	957 (7)	979 (11½)	815 (4)	83 (6)	26 (7½)	4 (1)
Banks	676 (21)	911 (15)	417 (18½)	48 (15)	40.5 (15½)	60 (20)
Barrow	857 (14½)	1,022 (10)	465 (15)	45 (17)	21.5 (4)	58.5 (17)
Elbert	741 (18)	838 (21)	473 (14)	56 (12)	45 (18)	33.5 (12½)
Franklin	682 (20)	858 (20)	361 (21)	42 (19½)	18.5 (3)	55 (18½)
Gwinnett	857 (14½)	904 (17)	773 (7)	85 (5)	32 (10)	25.5 (9½)
Hall	1,104 (2)	1,355 (2)	565 (13)	42 (19½)	12 (2)	44.5 (15)
Hart	918 (11)	1,041 (8)	455 (17)	44 (18)	50.5 (19)	55 (18½)
Jackson	1,047 (5)	1,137 (5)	747 (8)	66 (9)	40 (15½)	46 (16)
Madison	732 (19)	879 (18)	417 (18½)	47 (16)	56 (21)	61.5 (21)
Stephens	1,178 (1)	1,541 (1)	872 (3)	57 (11)	11 (1)	25 (9½)
Walton	954 (8)	1,052 (7)	404 (20)	38 (21)	26.5 (7½)	34 (12½)
21-County Averages	$ 937	$1,030	$ 682	66%	33	33
Rank Correlation Coefficient (with Nonagricultural Payroll Per Capita as the Independent Variable):	+0.644*	+0.425*	+0.701*	+0.540*	+0.275	+0.849*

[a] Because of space limitation, see my forthcoming monograph on Southern Piedmont for details on estimating and allocating procedures.

[b] The index is based upon the following per worker capital items: value of land and buildings, value of current inputs, and the index of livestock. The latter is in turn based upon the number of cattle and calves, milk cows, and pigs and hogs per worker. For explanation and justification of the method used, see fn. b, Table 5. Basic capital data are compiled or computed from census enumerations.

significant relationship (rho = +0.64*) between the level of industrial-urban development and farm income per worker on *all* farms. However, the relationship between industrial-urban development and farm income per worker on *commercial* farms yields a correlation coefficient of only +0.42*. On the other hand, the same relationship as applied to *part-time* farms gives a coefficient of +0.70* (Table 4). These (rank correlation) coefficients suggest that the commercial sector had been less responsive to the influences of differential industrial-urban development than the part-time sector. How do we explain this? In this connection, we hypothesize that this sectoral difference in the degree of responsiveness is to be explained by the difference in the type and magnitude of the adjustments

more during the calendar year or (b) the income from other sources exceeded that from sale of farm products. For our purposes, the distinction between part-time and residential farms is not particularly meaningful, since many, if not most, of the latter represented part-time farms with smaller output (value of products sold less than $250). As for abnormal farms, their number (exactly four in 1950) was most insignificant in the area. Thus, our reference to all "other" farms as part-time does no violence to accuracy.

undertaken in each agricultural sector in response to local industrial-urban development during 1940-50.

The commercial sector

In the 1950 Census, only a very limited number of capital items was given separately for commercial and part-time farms. Moreover, these items were stated in noncomparable units, and it is difficult to estimate the total value of farm capital for commercial and part-time farms. However, a crude index of capital per farm or per worker can be constructed on the basis of available information.[13] In these terms, the relationship between capital per commercial farm and industrial-urban development yields a correlation coefficient of +0.47*. Thus, commercial farms in the developed counties appear to have been more highly capitalized than those in the underdeveloped counties. The developed counties also reported larger numbers of workers per commercial farm in 1950. The correlation between workers per commercial farm and industrial-urban development yields a coefficient of +0.50*. If a measure of scale is constructed to reflect capital as well as labor inputs per farm, we find a significant relationship (rho = +0.56*) between the degree of industrial-urban development and the scale of commercial farms (Table 5).

These capital and scale indexes contain the land component expressed in value rather than in physical terms.

Examination of physical data showed no relationship between industrial-urban development and average size of commercial farm, in terms of either cropland or total farmland acreage (rho equals +0.13 and −0.03 respectively). However, if the land component is measured by average value of land and buildings per farm, the developed counties displayed distinct superiority over the underdeveloped counties (rho = +0.74*). Farm values tend to overstate the amount of capital inputs per commercial farm in the developed counties, since the higher land values of these counties reflect partly their greater competing nonagricultural land uses and more costly farm dwellings and better improved residential sites. However, the physical size of farms will understate the amount since higher land values of the developed counties undoubtedly stemmed in part from their greater past investments in *productive* land improvements.[14] At any rate, the scale of commercial farms would still be significantly associated with industrial-urban development (rho = +0.47*) if acres of cropland per farm were substituted for average farm values. However, these qualifications, together with an examination of original

[13] For information pertaining to the construction of such an index, see footnote b, Table 5.

[14] For evidence in support of this statement, see my Ph.D. thesis, *An Analysis of Southern Economic Development with Particular Reference to Agriculture, Southern Piedmont, 1900-40*, Vanderbilt University, 1955, pp. 248-54.

data, do suggest that the commercial farms of the developed counties did not have substantially more efficient scales than those of the underdeveloped counties.

TABLE 5. INCOME, WORKERS, AND CAPITAL PER FARM, COMMERCIAL AND PART-TIME, 1949–50, SOUTHERN PIEDMONT

(Ranks in Parentheses)

County	Farm income per farm, 1949[a]		Number of farm workers per farm, 1949[b]		Index of capital per farm, 1950[b]		Index of scale on commercial farms, 1949–50[c]
	Commercial	Part-time	Commercial	Part-time	Commercial	Part-time	
Anderson	$1,896 (10)	$371 (16)	1.936 (7)	.744 (9)	25.5 (2½)	22.0 (2)	32.5 (2½)
Cherokee	1,951 (8)	538 (2)	1.901 (8)	.528 (18)	46.0 (12)	48.0 (12)	54.0 (11)
Chester	1,788 (13)	331 (20)	1.945 (5½)	.718 (11)	45.0 (11)	32.0 (5)	50.5 (10)
Greenville	2,154 (3)	486 (4)	2.006 (2)	.455 (20)	30.0 (5½)	51.0 (14)	32.0 (2½)
Lancaster	1,631 (17)	336 (19)	1.753 (14)	.422 (21)	73.5 (21)	45.5 (10)	87.5 (21)
Oconee	2,112 (5)	527 (3)	1.732 (16½)	.786 (8)	59.0 (17½)	54.5 (17½)	75.5 (17)
Pickens	1,763 (14)	469 (7)	1.945 (5½)	.588 (13)	29.5 (5½)	43.0 (9)	35.0 (4)
Spartanburg	2,513 (1)	404 (13)	2.072 (1)	.564 (15½)	37.0 (9)	31.0 (4)	38.0 (6)
Union	1,693 (15)	386 (15)	1.967 (4)	.564 (15½)	51.5 (14)	56.0 (19)	55.5 (12½)
York	1,959 (7)	401 (14)	2.000 (3)	.492 (19)	25.0 (2½)	15.0 (1)	28.0 (1)
Banks	1,552 (19)	438 (11)	1.704 (18)	1.049 (2)	58.5 (17½)	49.5 (13)	76.5 (18)
Barrow	1,805 (11½)	483 (5)	1.765 (13)	1.038 (3)	34.0 (7)	29.0 (3)	47.0 (8)
Elbert	1,451 (20)	327 (21)	1.731 (16½)	.692 (12)	57.0 (16)	36.0 (7½)	73.5 (16)
Franklin	1,384 (21)	346 (17)	1.613 (19)	.959 (5)	36.0 (8)	35.5 (7½)	55.0 (12½)
Gwinnett	1,665 (16)	440 (9)	1.842 (10)	.569 (14)	38.5 (10)	52.5 (15½)	48.5 (9)
Hall	2,097 (6)	410 (12)	1.548 (20)	.727 (10)	47.0 (13)	76.0 (21)	67.0 (15)
Hart	1,809 (11½)	440 (9)	1.738 (15)	.966 (4)	64.0 (19)	47.0 (11)	79.0 (19)
Jackson	2,142 (4)	604 (1)	1.884 (9)	.808 (7)	52.5 (15)	53.0 (15½)	61.5 (14)
Madison	1,592 (18)	441 (9)	1.811 (12)	1.058 (1)	72.0 (20)	55.0 (17½)	84.0 (20)
Stephens	2,330 (2)	480 (6)	1.512 (21)	.551 (17)	16.0 (1)	59.0 (20)	37.0 (6)
Walton	1,927 (9)	341 (18)	1.831 (11)	.844 (6)	26.5 (4)	33.5 (6)	37.5 (6)
21-County Averages	$1,926	$434	1.869	.636	44.0	44.0	55.0
Rank Correlation Coefficient (with nonagricultural Payroll Per Capita as the Independent Variable):	+0.616*	−0.071	+0.503*	−0.859*	+0.467*	+0.097	+0.558*

[a] Number of farms from *United States Census, 1950, Agriculture*, County Table 6.

[b] The index is simply the rank order of the sum of each county's ranks in terms of the following measures of capital components: value of land and buildings per farm, current inputs per farm, per cent farms with one or more tractors, and livestock per farm. The latter measure is in turn represented by a single rank index based upon each county's sum of ranks in terms of numbers of cattle and calves, milk cows, and pigs and hogs per farm. These procedures are employed because the 1950 census fails to provide sufficient data in value term, by commercial and part-time farms, for us to derive total capital data. Although its construction appears extremely crude, actually the index when ordered (i.e., ranked) gives us a very close approximation of the "first principal component" of a given number of variables (types of capital in this case). The first principal component may be defined as a new "derived" variable which accounts for a greater part of the total variation contained in the original variables than any other "derived" variable.

Although the first principal component does not account for all the variation, it represents the original variables taken as a group more adequately than any other measure that may be derived. Evidently, then, insofar as our index when ordered closely approximates the first principal component, it would be difficult to derive a better single measure of capital per farm. For those readers with some degree of familiarity with statistics, particularly multivariate analysis, the following passage from Kendall's *Notes on Multivariate Analysis* (Virginia Polytechnic Institute, Blacksburg, Virginia, Mimeo., 1954, p. 28) may be of interest: "Such a procedure, in fact, maximizes the average Spearman correlation between the ranking so reached [ranked index in our case] and the rankings according to the [original] variates. The rank-vector therefore gets as close to the rank-vectors [of the original variates] as it can, so to speak, and will approximate . . . the first principal component." In the same work Kendall ranked 48 counties according to the yields for each of the 10 specified crops, summed the ranks for each county and compared the order of the rank sums with that given by the first principal component. He found that the agreement was strikingly close as indicated by rho = 0.99 (*ibid.*). For Kendall's exposition on component analysis, see Chapter 2 (pp. 7–29) of his manuscript.

[c] This index is the sum of each county's ranks in terms of the following variables: number of workers per farm, value of land and buildings per farm, index of livestock per farm, per cent farms with tractors, and value of current inputs per farm. It is then simply the sum of the index of capital per farm (Col. 5) and the county rank (in parentheses) representing number of farm workers per farm (Col. 3). This index when ranked (number in parentheses) is also a close approximation of the first principal component. Since this index treats labor as a single component but not capital (whose components enter into the index separately), one might argue that too much weight is given capital. However, even if capital is treated as a single component, the resulting new index remains essentially unchanged. Thus, the correlation coefficient between this index and industrial-urban development is +0.567* as compared with +0.558* in the table.

On the other hand, in terms of factor combinations, the developed counties' commercial farms showed no consistent differences from the underdeveloped counties'. In 1950, there was no significant relationship between the index of industrial-urban development and that of capital per worker on commercial farms (rho = +0.27, Table 4). We conclude, therefore, (1) that the dominant type of adjustment on commercial farms in response to local industrial-urban development has been changes in scale rather than changes in factor combination, but (2) that these scale changes did not differ substantially between the developed and underdeveloped counties. Consequently, commercial farms of the former counties were not greatly more efficient in scale in 1950 than those of the latter counties. Underlying this finding is the fact that scale adjustments represent a relatively slow and difficult process because of the restrictions imposed by imperfections in the capital market, difficulties in land transfers, inadequate managerial talent, and the dependence of these adjustments upon adequate outflow of farm operators. Given relatively small differences in scale, one would expect also relatively minor differences in physical productivity of labor and in farm income per worker in the commercial sector between the developed and underdeveloped counties.

To what extent do county differences in income per worker on commercial farms reflect actual differences in physical labor productivity (an indicator of the effect of scale on returns)? On the basis of our earlier studies,[15] there can be little doubt that part of the developed counties' higher farm incomes can be attributed to existing imperfections in the product market. Because of the salutary effects of industrial-urban development upon the efficiency and competitiveness of local product markets, the developed counties' farmers tended to receive higher prices for their products and pay lower prices for their inputs. The creation of new markets for certain farm products as a direct result of urban growth (and rises in per-capita income) also tended to give these farmers opportunities to engage in income-raising product innovations. Moreover, imperfections in product markets tended to put the developed counties in a position to market greater proportions of some of their farm products (e.g., milk) in the most favorable form (fluid milk) in terms of price. Since income differences arising from these sources in no way imply differences in physical productivity, the use of income data tend to *overstate* the effect of the developed counties' greater scale upon productivity of labor and per worker income. Thus, if it were possible to secure income data reflecting *only* the income effect of scale, the relationship between per worker income so obtained and industrial-urban development would be even weaker than that shown earlier (+0.42*).

[15] *Ibid.*, ch. IV.

The part-time sector

In 1950, the part-time farms of the developed counties were no larger than those of the underdeveloped counties, as shown by the noncorrelation (rho = −0.10) between industrial-urban development and value of capital per farm (Table 5). Yet, with far less labor per farm, the part-time farmers of the former counties realized incomes (per farm) comparable to those received by their counterparts in the underdeveloped counties. This is clear from the high negative correlation (rho = −0.86*) between industrial-urban development and the number of workers per part-time farm and from the lack of relationship (rho = −0.07) between industrial-urban development and farm income per part-time farm. Thus, it is not surprising that we should find substantially higher income and capital, when stated in per-worker terms, in the developed counties. The correlation between industrial-urban development, on one hand, and income and capital per worker on part-time farms, on the other, yields coefficients of +0.70* and +0.85* respectively (Table 4).

What sort of inferences can we draw from these relationships? Let us begin by noting that the greater diversion of available family labor force from part-time farms to off-farm employment was achieved in the developed counties apparently without compensating increases in capital inputs and without lowering per-farm incomes to a level below that prevailing in the part-time sector of the underdeveloped counties. This leads to two important conclusions: (1) Increased ratio of capital to labor, primarily through decreases in labor, had been the dominant type of adjustment within farm firms of the part-time sector. (2) Modern part-time farms represented small subsistence units of the past with much initially underemployed family labor with the result that later diversion of even a substantial part of this labor[16] to off-farm work did not appreciably decrease output per farm. Insofar as the diversion of labor can be made without increased capital and without much loss of farm income,[17] this type of adjustment not only can be effected easily but offers very strong inducement to small farmers faced with off-farm employment opportunities.

The strong negative relationship (rho = −0.86*) between workers per part-time farm and industrial-urban development suggests that the extent to which farm labor may work off-farm (without changing residence) was determined by the availability of nonfarm work within reasonable commuting distances. There is also some indication that nonfarm jobs were rationed in favor of nearby residents.[18] Thus, the more abundant non-

[16] Much of it was female because of the importance of textiles in the area.

[17] It is well to add that the greater diversion of the developed counties' labor from the part-time sector to off-farm employment may well have reduced their real output per farm to a level below that of the underdeveloped counties. This, however, was apparently offset by the more favorable prices (received and paid) that accrued to the former counties' farmers under their more efficient product markets.

[18] *Ibid.*, pp. 274-79.

farm job opportunities of the developed counties were limited largely to the farm families of the same counties. This is consistent with the high positive correlation (rho = +0.72*) between per cent of all farm-operator man-years spent on off-farm work in 1949 and the degree of industrial-urban development. That the relative importance of off-farm work varied greatly among counties in 1949 is clear from the fact that in four of the area counties nearly 40 per cent of their total number of operator man-years were spent on off-farm work while in four other counties the figure was only 14 to 17 per cent.

In summary, the dominant type of adjustment in the part-time sector was a change in factor combination primarily through reductions in formerly underemployed family labor. Adjustments of this type were (1) easily effected, (2) dependent upon the availability of local off-farm employment opportunities, and (3) unaccompanied by noticeable falls in output. It is not difficult to see then why this sector should have been highly responsive to local industrial-urban development which gave rise to nonfarm employment. Nor is it difficult to see why extensive adjustments of this type reported by the developed counties should have raised their farm income per worker substantially above that in the underdeveloped counties. Finally, we conclude that it is because of the totally different nature of their internal adjustments that the two agricultural sectors showed different degrees of responsiveness to the positive income effect of local industrial-urban development. Our empirical findings are, therefore, quite consistent with our hypothesis. Insofar as the part-time sector displayed far greater responsiveness, the continued divergence during 1940-50 in labor productivity and income per worker in agriculture between the developed and underdeveloped counties appears to be explainable largely by developments in this sector.

A comparison

Data in Table 5 clearly show that in all counties the commercial sector reported higher farm income per worker than the part-time sector. If farm income per worker on part-time farms is stated as a percentage of that on commercial farms important county variations readily come to light. In 1949, this percentage ranged from a high of 99 per cent in Greenville and Cherokee Counties to a low of 38 per cent in Walton County. Moreover, county variations in this respect are significantly correlated (rho = +0.54*) with those in the degree of industrial-urban development. In other words, in terms of farm income per worker, the part-time sector was more nearly equal to the commercial sector in the developed counties than in the underdeveloped counties. This is in line with our earlier conclusion that income per worker in the part-time sector differed more between the developed and underdeveloped counties than did those in the commercial sector.

Why did the part-time sector consistently report lower income per

worker than the commercial sector, despite the latter's slower response to local industrial-urban development? Certainly, the part-time sector had no less capital per worker than the commercial sector. In 1950, on a per-worker basis, the part-time sector of the study area as a whole, as compared with the commercial sector, reported larger numbers of acres of cropland, cattle and calves, milk cows, and hogs and pigs, but less current inputs. However, the sectorial differences are by no means consistent. If a variance analysis is made, we find that the part-time sector differed significantly from the commercial sector with respect to only milk cows and hogs and pigs per worker. The number of tractors per worker, however, almost certainly gave some edge to the commercial sector, although it is not susceptible to measurement for lack of separate census counts for commercial and part-time farms. Thus, while it is difficult to state meaningfully the exact sectorial differences in capital per worker, the two sectors were probably about equal in 1950 in this respect, with the part-time sector perhaps having a slight edge.

How then do we explain the observed sectorial differences in farm income per worker? Examination of census data for state economic areas reveals that, for the economic areas comprising the study area, the part-time sector reported consistently higher average operator age than the commercial sector, although the difference was small. Far more important is the adverse effect of off-farm employment upon the age composition (hence, average labor productivity) of the "residual" labor devoted to agriculture. Off-farm employment of farm persons tends to select those in the most productive age groups.[19] Since the labor force estimates used in this paper are not refined to allow for age differences among workers, the unfavorable age composition of the labor force on part-time farms accounts in part (perhaps in large part) for the relatively low level of income per worker in this agricultural sector. A further consideration is that part-time farming tends to suffer in efficiency since on farms where the bulk of family income comes from nonfarm sources the role of farming is subordinated to that of off-farm activities. Finally, sectorial differences in the average size of farm firms may well explain some of the observed differences in farm income per worker between the two sectors.

Thus, there appear to be many likely explanations for the sectorial income differences. But not all explanations imply differential efficiency. Although it is plausible to conclude that part-time farming represents a relatively inefficient way of farming, the sectorial difference in efficiency may be relatively unimportant. Moreover, the relative efficiency of part-time farming improves with local industrial-urban growth. Lastly, the application of strict efficiency criteria to part-time farming may be inap-

[19] See, for instance, Vernon W. Ruttan's article, "The Impact of Urban-Industrial Development on Agriculture in the Tennessee Valley and the Southeast," *Journal of Farm Economics*, XXXVII, February 1955, p. 48.

propriate for two reasons. Firstly, part-time farming is often considered a means of cushioning the effect of possible industrial unemployment. Secondly, in more extreme cases, part-time farms are little more than rural residences. To apply efficiency criteria to such cases is almost tantamount to applying them to a case where a man paints his own house on weekends. At any rate, since part-time farming, as a method of farm reorganization, cuts across the agricultural and nonagricultural sectors, its income effect should be judged only after the inclusion of added income from nonfarm sources. When so viewed, the part-time sector compared favorably with the commercial sector in income per person gainfully engaged.

V. *Conclusions*

In the Southern Piedmont, the relatively strong positive income effect exerted by industrial-urban development upon local agriculture was largely the result of the ability of such a development to absorb formerly underemployed farm labor. Adjustment of this type substantially increases farm income per worker since it reduces the number of workers in agriculture without affecting total output appreciably. Bearing this finding in mind, what can we say of the future if industrial-urban growth continues to concentrate in those areas that already have substantial development? A reasonable speculation is that the income effect of industrial-urban development will diminish in the future as farm labor underemployment disappears in the developed areas. With continued disappearance of disguised unemployment in these areas, further transfers of farm labor to the nonagricultural sector will be accompanied by increasingly larger decreases in total farm output, thus, cutting down on the increases in farm income per worker. Meanwhile, the underdeveloped areas still with substantial underemployment will continue to move up in farm labor productivity at about the same rate if outmigration and off-farm employment (though limited) of their redundant farm labor proceed as in the past.

This speculation even today is not without some factual support. Thus, the nation as a whole—which in 1940 had undoubtedly less underemployment than the study area—lost some ground relative to the Southern Piedmont during the 1940's with respect to agricultural labor productivity.[20]

[20] Data in Table 1 and accompanying footnotes show that farm income per worker was $296 in the Southern Piedmont in 1940 or 47.1 per cent of the national average ($628). By 1950, the area average ($1,023) had risen to 52.2 per cent of the national average of $1,957. This closing of the gap would be more significant if income from off-farm employment is included. Thus, in terms of median (net cash) income of farm families and unrelated individuals from all sources, the average for the study area in 1950 was fully 64 per cent of the U. S. median of $1,567. In fact, in that year, two area counties reported median incomes only 4 per cent below the national median.

On the other hand, within the study area, the decade witnessed a trend toward increasing income disparity between the developed and underdeveloped counties. Furthermore, as the resource and income problems of the developed counties' agriculture are gradually solved, beneficial effects of their future industrial-urban growth will accrue in increasing proportions to their less fortunate neighbors. Such a diffusion of effects may take the form of increased intercounty migration as local nonfarm job rationing lessens.

From the standpoint of public policy, is there anything useful that may be said on the basis of the findings presented in this paper?

The decade 1940-50 represents a highly unusual period, blessed with conditions that are conducive to greater equality in factor returns (and average incomes) among areas. Yet in the small, relatively homogeneous Southern Piedmont the decade witnessed a trend toward increasing disparity in farm income per worker among counties. This suggests that, within the framework of existing markets and development patterns, other remedial action programs must supplement full-employment policies, if quicker and fuller relief is to be given to the depressed farm areas. In this connection, we consider appropriate all measures designed to overcome market imperfections, to increase resource mobility (particularly that of labor), or to remove existing statutes that hamper the much-needed adjustment process.

A more specific recommendation has to do with the encouragement of part-time farming as a means of absorbing existing underemployed farm labor. Part-time farming as a method of farm reorganization is probably matchless in its simplicity and responsiveness. It requires no population movement, which usually means painful economic and social adjustments on the part of migrants and their families as well as communities at both ends of the migration routes. Nor does it require increased capital and land inputs and the managerial ability that is necessary to go with enlarged enterprises. Nor does it require changes in farm enterprise combination or adoption of new products—the successful management of both of which may require a degree of competence that low-income operators do not possess. But part-time farming is feasible only if there is local industrial-urban growth. Thus, with due consideration to efficiency and regional comparative advantage, a sound public policy may well consider means of encouraging the growth of industries in the depressed farm areas. In this connection, we recommend the abolition or revision of the minimum wage law to allow the free play of regional wage differentials, the inclusion of disguised agricultural unemployment in designating "labor-surplus" areas, and the implementation of more effective measures to encourage industrial-urban development in farm

areas so designated. Along the latter line, action programs should recognize that a major roadblock to industrialization in these areas lies in their present deficient public services—a situation aggravated by outmigration and subsequent shrinkage in local tax base. As possible means of overcoming this obstacle, two measures suggest themselves. (1) Provision of rapid amortization (insofar as it implies interest-free loans) as an aid to incoming industries in their attempt to make up for local deficiencies. (2) Supplementary federal grants-in-aid, where necessary, to increase local public services to a level that meets the reasonable requirements of incoming firms. These programs might be financed with funds released by concurrent cutbacks in the price support program.

ON PRICE DETERMINATION AND AGGREGATE PRICE THEORY

HAROLD F. BREIMYER
United States Department of Agriculture

WHAT MAKES PRICE? has long been a central question in economic theory. The question is of special importance to economists concerned with agriculture, where price is the more vacillating member of the price-quantity duo and where quixotic price trends do not escape political notice.

Since the appearance of the Austrian school, considerations of utility and concepts of consumer behavior have dominated price theory. Most texts and articles on price treat elaborately of the dominant role of the consumer. They develop highly rationalized equilibrium analyses assessing the interaction of consumer and supplier in creating price-making forces. Even analysts of prices of intermediate goods, such as livestock feeds, commonly assert their allegiance to consumer demand for the ultimate product.[1] Modest digressions have recently appeared, such as the construction of structural-flow charts to lay out diagrammatically the mosaic of market movements and market-price-shaping forces.[2] Just now there is a spate of consumer surveys. Consumers throughout the nation have suddenly become subjected to immoderate catechisms of their behavior. They are asked for a record of their explicit performance as shoppers and are searched for a psychic explanation of their reasons therefor. Nationwide consumer expenditure surveys add to the mass of raw data. These are the latest forms that allegiance to theory have taken.

Inherent in most price analyses is a concept of the efficient workings of the market mechanism, the formal specification of which is known as perfect competition. A reasonable approximation of that state is implicitly assumed, in disregard of the well known divergence from it in the real world, and in violation of Chamberlin's insistence that abstracting from monopoly is better than from perfect competition.[3]

This article is not intended to be a rehash from the multitude of

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[1] Rightly so, but the departure over several decades from preoccupation with the wholesale commodity price index is significant. Analytically, a demand shifter less remote than consumer income can be employed, general demand being implicit in the limited factor actually chosen. Cf., Richard J. Foote, John W. Klein, and Malcolm Clough, *The Demand and Price Structure for Corn and Total Feed Concentrates*, U.S. Dept. Agr. Tech. Bul. 1061, 1952; and for more specific discussion of this point, Richard J. Foote, *Statistical Analyses Relating to the Feed-Livestock Economy*, U.S. Dept. Agr. Tech. Bul. 1070, June 1953, p. 8.

[2] E.g., Foote, et al., *op. cit.;* and Karl A. Fox, *The Analysis of Demand for Farm Products*, U.S. Dept. Agr. Tech. Bul. 1081, 1953.

[3] Edward H. Chamberlin, *Theory of Monopolistic Competition*, 1939.

analyses of oligopoly, monopolistic competition, or other deviations from the classical ideal. Rather, if one may presume to claim such distinguished antecedence, my aim is as Professor Taussig once wrote, ". . . to point out some modifications or corrections of the usual statement of the theory of demand and the interplay of supply and demand. The suggestions (may not be) novel; nor do they tend to alter the essentials of received economic theory. But they may indicate wherein current versions are not in accord with the course which prices take under some familiar conditions. . . ." So wrote that grand gentleman in 1921 who, after looking at the real world in relation to inscribed theory, reported to his colleagues what he saw.[4]

Let it be understood that the intent here is not to prejudice the demand analysis now being carried on. Most is competently done and worthwhile. The plea is against its sufficiency. "There is more under heaven and earth . . ." than formal statistical demand analyses can show.

Few farm products are sold under perfect competition, and some are sold under conditions that make pricing indeterminate. A case will be made for less aggregation in price analysis, and for more attention in analysis to the supply side of the supply-demand equation. The concept of reservation demand will be reintroduced. Finally, pricing at successive stages of marketing will be considered and a selected example presented. Many of the references will be to pricing in the commodity area of livestock and their products. This is the area in which the author is professionally engaged. The area offers examples both of nearly-free market pricing and of its variants and opposites.

Perfect Competition Infrequent

It is singular indeed that equilibrium analysis of market prices of farm products is being carried on so assiduously at a time when conditions of perfect competition in pricing are becoming ever rarer. Formerly, those conditions were more nearly approximated in pricing agricultural products than anywhere else in the economy. Professors of economic theory who often could not distinguish wheat from parsley habitually cited the wheat market to exemplify what Marshall was talking about. But, one by one, farm commodities have come under the influence of government price supports: cotton, wheat, rice, peanuts, tobacco, corn, oats, barley, grain sorghums, dairy products. Many fruits and vegetables are marketed and priced under public or private arrangements that depart from the specifications of perfect competition.

Nor are these the only defections. Meat animals are still free of direct government control. Yet in them we have seen a marked trend away from

[4] Frank W. Taussig, "Is Market Price Determinate?" *Quarterly Journal of Economics*, 35:394.

central marketing, which presents a reasonable replication of perfect competition, to direct marketing, which bears little resemblance. These animals are the source of 30 out of every 100 dollars of farmers' cash receipts.

Professor Taussig's tally of causes for indeterminateness in pricing omits all reference to monopoly or to monopolistic competition. That field was to be plowed a few years later. Many works are now available on pricing under the various competitive imperfections. One has dealt comprehensively with imperfect competition in agriculture.[5] The several authors are not entirely agreed as to how determinate pricing may be under the assorted conditions of monopoly, but most admit to a considerable indeterminateness. Boulding, for example, in his standard textbook, notes first that under monopolistic competition there can be no single price at which the product of an industry is sold. Then he adds that under perfect oligopoly the problem of pricing and market capturing may "become one of great complexity" while imperfect oligopoly "may not allow a position of stable equilibrium."[6]

The current trend toward direct selling of livestock is a trend toward the extreme or limiting case of imperfect competition—that of one buyer and one seller. The same is true of many sales of poultry, of wool, and of some other products.[7] Negotiation between a farmer and a packer-buyer over a pen of steers, far from being exactly controlled puppet-like by lines proceeding from a distant livestock market, is to considerable extent a matching of wits, one against one. And the product is differentiated, except when terms of the sale provide for carcass grading on the rail.

The difference between sale of a homogeneous product in perfect competition and of a differentiated product in direct sale is the difference between a process that has been thoroughly systematized by theoretical economists and one for which few theoretical and analytical tools have as yet been made available. Under perfect competition, each buyer and seller is considered to have a fixed mental schedule of what he will buy or sell at various prices (this assumption is more convenient than precisely accurate). Through perfect knowledge within the market, the price for a homogeneous product is determined to be one that makes the aggregated individual schedules balance. No buyer or seller is treated inequitably because the availability of supplies and of outlets at the going price is his protection.

The mental values in such supply and demand schedules have long

[5] William H. Nicholls, *Imperfect Competition Within Agricultural Industries*, 1941.
[6] Kenneth E. Boulding, *Economic Analysis*, 2nd Ed., 1948, pp. 579, 587, 590.
[7] On a catalog of all farm products, sale of eggs apparently comes closest to meeting the conditions of perfect competition.

thwarted curious economists who, determined to complete their rationalization, have developed indifference curves as a substitute technique. Essentially an indifference curve is a mechanism for equating a set, and then ranking several equated sets, of choices among two or more alternate values.[8] The device portrays subjective values for which the parameters cannot be known and only the manifestations are observable. Usually, the device demonstrates the psychics of comparative utility.

Also, indifference curves are employed in practice not to illustrate the procedure through which market prices are determined but to describe the state of affairs after prices have been made. They involve comparative statics. Specifically, they set forth the personal harmony of each consumer, possessed of his peculiar kit of desires and preferences, with the market.[9] The vital feature is tangency of the indifference curve and the price ratio line.

The distinguishing feature of determination of price in person-vs.-person bargaining, as direct sale of livestock, is the absence of other buyers and sellers so numerous and so immediately accessible as to make a given transaction negligible in the market and to convert all pricing into an aggregative process. (There usually is also differentiation of product in direct sale, but this is a separate consideration and not unique or identifying.) In its barest essentials person-vs.-person sale comes close to that of barter. As Marshall and many others have emphasized, the concepts of equilibrium and determinateness cannot be applied to barter. However, the indifference curve technique has been employed, first by Edgeworth, in this connection—to demonstrate not the determinateness but the indeterminateness of barter. Indifference curves do not show how a barter contract is arrived at, but rather set forth conditions describing possible final contracts. There are in fact an infinite number of potential contracts in barter, lying within a range bounded by curves passing through the original positions of the two bargainers. Each such contract is characterized by tangency between indifference curves. Comparative bargaining power of the adversaries determines which of the possibilities becomes the final contract.[10]

Most actual transactions are not exchange of goods for goods but of goods for money. The bidder for steers offers dollars, not a stack of straw

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[8] In principle it can be any number. Because of the limitation of graphics, the number is usually restricted to two or to three at the most. Cf. Frederick V. Waugh, "A Partial Indifference Surface for Beef and Pork," *Journal of Farm Economics*, February 1956, p. 109.

[9] Boulding asserts a demand curve can be derived from indifference curves. *Op. cit.*, pp. 753-7.

[10] Quoted from F. Y. Edgeworth, *Mathematical Psychics*, 1881, London, School Reprints of Scarce Works, 1932, by George J. Stigler, *The Theory of Price*, 1949, p. 79-81. The demonstration is worth review by those unfamiliar with it.

hats. The Edgeworth illustration for barter cannot be applied directly. Yet there is enough correspondence between two-party barter and two-party sale of a farm product for the barter analysis to have meaning and for the indifference technique to have application. The process of arriving at a contract in direct sale would seem to involve both a set of indifference relations and the theory of games. Games are involved in the uncertainty and in the reckoning of probabilities in the bargaining process. Neither bargainer knows what bids or offers can be anticipated from the other, yet both regard the pattern of successive proposals made as indicative of probable proposals forthcoming thereafter. The indifference aspect arises from each party's weighing and balancing of the probabilities in negotiation. Probably the two elements each party is matching to a point of indifference are (1) the further advantage to him of the most probable next bid or offer and (2) time. Time is important to both parties; neither can afford to negotiate indefinitely. A stage is reached in bargaining past which the possibility of further small advantage to be gained does not offset the added time and trouble required.

The hypothetical illustration below is offered as a variant from the indifference curves of Edgeworth. It pertains to price making in direct sale. The curves are not twins to Edgeworth's; they are not true indifference curves and can claim no closer kinship than first cousins. Like indifference curves they relate to the static conditions necessary for a contract. The curves are labeled as curves of equal probabilities in anticipated bids and offers. Like indifference curves of comparative utility they refer to mental judgments. They are built on the idea, believed realistic, that each of the two parties forms a mental image of the pattern of bids or offers the other party will make, and that this image is of the approximate curvature shown in the illustration below. That is, the seller typically expects that the buyer will step up his bid substantially early in the negotiations and that subsequent increases will be smaller and appear slower. Hence the curve gradually flattens. After nerves are frayed from long bargaining it may become apparent that protraction would lead to the buyer's retrenching to a less agreeable attitude, putting a "tail" in the curve. From the buyer's standpoint, the reasoning is similar but opposite. At final contract, each party assumes that no advantage is likely to be gained from further haggling—or, at most, the possibility thereof is not worth the time and effort that probably would be required.

The curves as plotted are illustrative only. The exact slopes shown are arbitrary and without significance. Figure 1.

These curves do not encompass all the elements in price making under direct sale. The theories of games and of indifference functions are far too complex for that. The aim is to adopt certain features of Edgeworth's

graphics to describe and emphasize the indeterminate qualities in person-vs.-person direct sale.

A-la Edgeworth and Stigler, a contract curve can be drawn in the illustration connecting the several positions of tangency. In principle there is no particular maximum length to the curve. In reality, however, a tacit range to bargaining sets a limit to its length. The range is governed by prices on an organized market, which keep bargaining within a certain

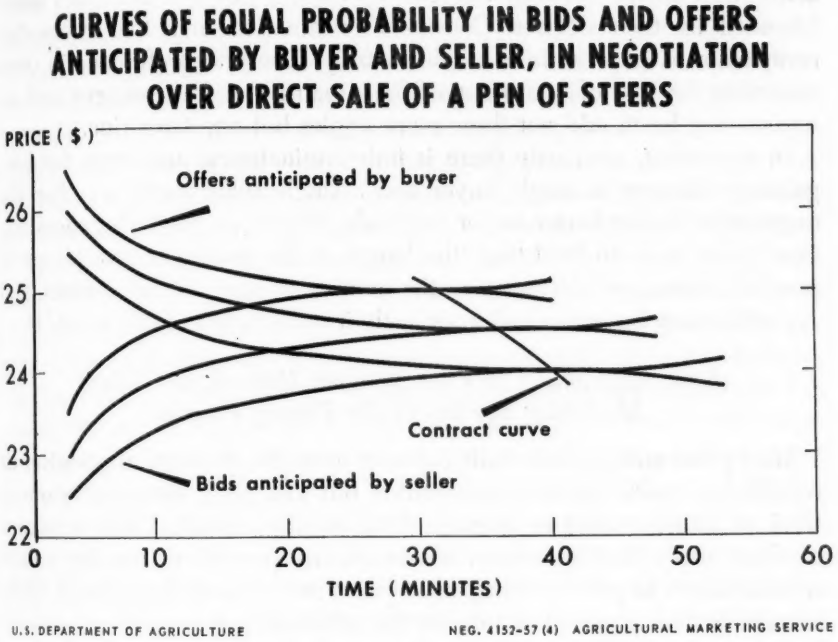

FIG. 1

price area. It could be described on the chart by a horizontal band, shaded heavily in the center to denote greater frequencies there and lighter at the edge (Taussig's penumbra?). Within this range, person-vs.-person contractual negotiation is truly indeterminate, and a pricing system involving it is to a degree indeterminate.[11]

An incidental aspect of these curves is that they can be plotted on a

[11] The area of indeterminateness, i.e., the range over which pricing is subject to the bargaining skill of negotiators, varies widely according to conditions such as the geographic nearness of an organized market, the degree of differentiation of the product, and the knowledgeability of each bargainer. Direct selling of cattle in the South has been subject to much indeterminateness and to wide variability in prices. Direct selling of hogs in the Corn Belt has had much more uniform pricing—but the trend toward segregating by grade and weight instead of by weight alone will add to variability in pricing.

single scale. Edgeworth's illustration of barter required that one set of curves be plotted on inverted scales. Also, by way of passing comment, any adaptation of indifference techniques to negotiation between two persons is free of the imperfections in many of their other uses. In two-party sale there is discrete decision between two values. No other considerations enter in. This situation is clearly more valid than the application of indifference curves in their common current usage of equating consumer's choice between two commodities, a purpose doubtless never intended by their deviser. Consumer's evaluation in a two-commodity comparison is impossible to establish truly. The first preference in compensating for loss of one orange from a pairing of four oranges and six apples may be to add not three more apples but one tangerine.

In any event, obviously there is indeterminateness and room for bargaining whenever a single buyer and a single seller meet, whether the negotiation be for barter or for cash sale. Moreover, Stigler's generalization would seem to hold that "the length of the contract curve (range of possible exchanges) decreases as the number of bargainers increases, and . . . with many buyers or sellers or both, it reduces to a single point."[12]

Less Aggregation in Price Analysis Desired, and More Marketing Studies of the Pricing Process

Most price analyses are built not only upon the theoretical premises of equilibrium under perfect competition but also on a statistical groundwork of national total or average data, usually annual. Their form and conduct imply that somehow, someway, irrespective of varying actual circumstances in price making, most prices seek a level determined fairly accurately over a period of time by the substantive forces affecting them. Government pricing as a departure is usually recognized, but other special conditions by commodity, by area, or by period of time, are often disregarded.

The problem has not gone unnoticed. Fox, in an excellent study, apologizes for so much aggregation as unfortunately required to reduce the number of variables to manageable proportions and to economize on costs in collecting and analyzing data. He adds that "a more formal consideration of the relationships of national aggregates to subaggregates, and even to individual firms and consumers, would be worthwhile."[13]

A first weakness in over-aggregation is that it is directed to questions too far removed from actual events about which producers, marketers and consumers want answers. If there is geographic variation in prices,

[12] George J. Stigler, *The Theory of Price*, 1949, p. 81.

[13] Karl A. Fox, *The Analysis of Demand for Farm Products*, U.S. Dept. Agr. Tech. Bul. 1081, 1953, pp. 23-4.

explanation is sought on prices in one's own area.[14] If there is weekly, monthly, or seasonal variation, wisdom is asked on less than annual average prices.[15] These are among the weaknesses Fox had in mind.

A perhaps even more damaging criticism of over-aggregation is of different nature. Regrettably, aggregative equilibrium analysis connotes an efficiency, if not beneficence, of the marketing and pricing process that is not justified. A routine explanation of farmers' prices is that they are simply a derived value, calculated to be the price to consumers as established by supply and demand minus a nearly fixed marketing charge. If pricing were in fact so exact and determinate, the individual farmer would be fortunate indeed. The particular farmer who knows he has just been deceived, hoodwinked, and outmaneuvered in selling his potatoes, his livestock, or his wool finds small comfort in pedagogical explanations of aggregative price-making forces. A naval experience comes to mind. A flag officer was approached with a protest that an enlisted man accused of misconduct was getting less than the full protection supposedly assured in writ. The response was a pontification that "I'll have you know Naval justice is the best in the world." No chance for individual miscarriage of justice in this convenient generalization! Similarly, over-trust in the workings of the price-determining mechanism has dimmed interest in examining the actual performance of pricing in individual sales. Partly for this reason, the recent expansion of marketing research has found little room for research into price determination at point of first sale. And as noted above, price analysts have paid too little note to the nature of a commodity and the setting for its pricing as an analytical consideration. Years ago, when economists were less sophisticated about price theory and really worried about how farmers fared vis-a-vis their adversaries in the market place, more probably was known than now about how prices are actually arrived at.[16,17]

Supply Analysis

Demand has been analyzed, cross-analyzed, re-analyzed without respite. Ingenious demand shifters have been worked up. Yet the supply curve and

[14] Karl A. Fox and Richard C. Taeuber, "Spatial Equilibrium Models of the Livestock-Feed Economy," *American Economic Review*, 45:584-608, is an example of geographic analysis.

[15] Jerry Foytik, "Characteristics of Demand for California Plums," *Hilgardia*, 20:407-527, presents an example of strictly short term price analysis.

[16] This is not to minimize the considerable good work done. Among workmanlike recent articles is W. K. McPherson, "How Well Do Auctions Discover the Price of Cattle?" *Journal of Farm Economics*, Feb. 1956, p. 30.

[17] This paragraph bears on equity. Equity has come to be a familiar concept in price and income relationships between agriculture and the rest of the economy. Too often forgotten is the responsibility of the pricing system for equity among its individual participants.

its shifts remain an area of ignorance. Fox did not even accord supply a place in the title of his bulletin on price analysis, and only a single page in the text.[18] It has seemed necessary to apply price analysis to time periods for which supply could be regarded as essentially predetermined. Periodicity in production of farm crops and even some livestock has made such a problem-avoiding compromise possible. Yet surely supply is not an inactive partner. Quite the contrary, it is often the aggressive if not misbehaving agent. Taussig, in the article quoted at the outset of this paper, narrated the paradox that has so delighted iconoclasts among students in economics, whereby withholding eggs from the market on a price rise amounts to a negatively-inclined supply curve.[19] He went on to list other peculiarities of the supply function. Cochrane is one of those who recently cited the "need to develop some reliable supply relations for use in predicting output responses"—adding "in the short and longer runs, by commodities and in the aggregate."[20, 21]

A regrettable outgrowth of analytical difficulty in isolating supply curves is a tendency to interpret economic events in terms of demand alone. To what extent are surprisingly weak prices for farm products the last few years to be attributed to shifts in the supply curve as opposed to shifts in demand? Consumers are spending fewer dollars for pork than a few years ago. Has only demand changed, or supply relations too? In classic expositions, Working and Ezekiel called attention to the problem of identification, and Fox and Foote have elaborated more recently.[22] On the conundrum of supply vs. demand for meat, Shepherd, Purcell and Manderscheid made similar observations and raised similar questions.[23]

For short-run pricing, more is needed than "output response." What determines market supplies, today, tomorrow, next week, next month? If price making is a scissors action, how can we understand it without understanding supply? Taussig insisted that price theory worked really

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[18] Fox, *op. cit.*

[19] Taussig, *op. cit.* pp. 395, 401.

[20] Willard W. Cochrane, "Agricultural Economics in the Decade Ahead," *Journal of Farm Economics,* December 1954, p. 822.

[21] For analysis of output of livestock products, the several livestock-feed price ratios still have much validity. A recent study of the hog-corn ratio, for example, is George E. Brandow, *Factors Associated With Numbers of Sows Farrowing in the Spring and Fall Seasons,* Agr. Exp. Sta., Pennsylvania State Univ. A. E. & R. S. #7, August 1956. An attempt to unravel the complex supply relationships for beef cattle is Harold F. Breimyer, *100 Million Cattle?—A Review of Projections and Methods of Making Them,* U. S. Agr. Mktg. Serv., mimeo., July 1954.

[22] A summary and references are in Richard J. Foote, "A Comparison of Single and Simultaneous Equation Techniques," *Journal of Farm Economics,* Dec. 1955, p. 975.

[23] Geoffrey Shepherd, J. C. Purcell, and L. V. Manderscheid, *Economic Analysis of Trends in Beef Cattle and Hog Prices,* Iowa Agr. Exp. Sta. Res. Bul. 405. Jan. 1954.

well only if supply were fixed; or, as he elaborated, "fixed . . . , unalterable during the period under consideration, and (entirely) sold. . . ."[24] Seldom is this condition accommodated.

Analytically, the technique of simultaneous equations is well suited to price analysis in which supply is not predetermined. Excellent discussions in recent literature will not be repeated here.[25]

Reservation demand, a term used, if not developed, by Mordecai Ezekiel in a memorable study is applicable.[26] Reservation demand relates to the supply function of the very short run. It is not output response but a market-release function, concerning the rate at which a stock of a good is released into market channels. Reservation demand is both a supply and a demand function, for it is a supplier's own withholding demand determining the quantities supplied on a daily or weekly market. L. H. Bean elaborated on the idea of reservation demand, treating of the "farmers' reservation-demand schedule" and applying it to "commodities of fixed annual supply." He chose potatoes for an example. The ". . . farmers'-demand or reservation schedule . . . indicates the quantities retained or utilized for the several purposes on the farm (food, feed, seed) for the different price conditions. Given a total production, it is possible to deduct the quantities in the reservation schedule to obtain the different quantities that farmers would release to the local dealers or markets at different prices."[27] Bean presented a set of three demand curves for potatoes: a farm (reservation) curve projected on quantities retained by farmers, a dealer curve for quantities sold, and a combined farm and dealer curve for total production.

Reservation demand fits best of all the pricing when government supports are operative.[28] The support price is a built-in reservation demand; it offers recourse at the support level. Figure 2, developed by Malcolm Clough of AMS, relates placement of corn under support and the difference between price received by farmers and support price.[29] The chart shows an overall regression and affords in fact several regressions, the two plotted applying (1) to all years (solid line) and (2) to those years (dashed line) when there were no allotments and all producers were eligible for support. In addition, it indicates a semblance of the free-

[24] Taussig, *op. cit.* p. 397.

[25] Cf. Foote, *op. cit.*

[26] Mordecai Ezekiel, "Statistical Analyses and the 'Laws' of Price." *Quarterly Journal of Economics,* Feb. 1928, p. 199.

[27] Louis H. Bean, "Characteristics of Agricultural Supply and Demand Curves." Summary of address before Amer. Assn. for Adv. of Science and Econometric Society, June 1932, U. S. Dept. Agr. (mimeo).

[28] It applies, naturally, only to eligible producers.

[29] The chart refers to total placement, of which some was redeemed before year's end. However, if net placement be regarded as more apropos, a regression is found for it also.

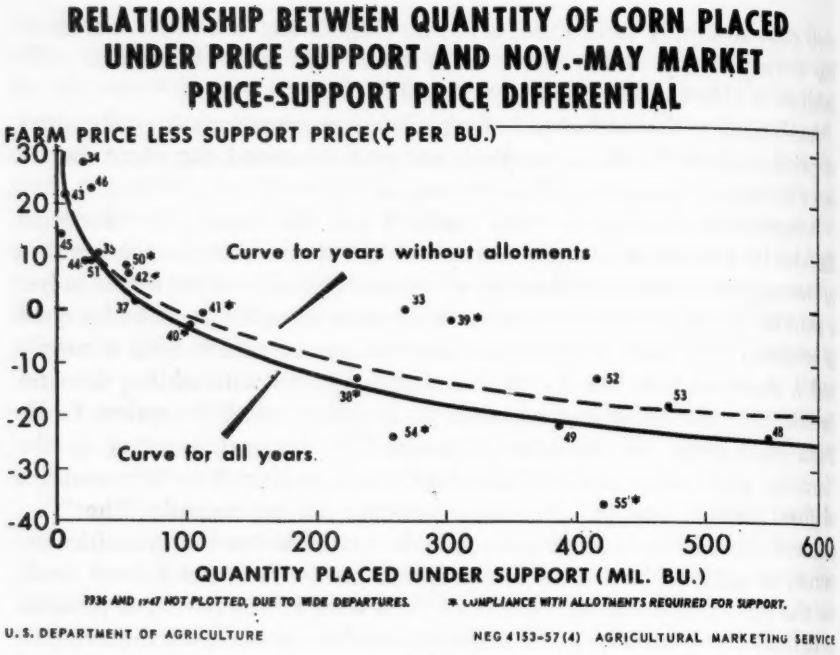

FIG. 2

market reservation demand Bean referred to, for if the data are observed for only the years when prices were above support (upper left portion of chart), even in the small-scale plot a regression relationship can be seen.[30, 31]

Reservation demand thus has its clearest demonstration with reference to how a producer releases into the market over a season his stock of a stable commodity produced at one time each year.[32] The concept is

[30] A analysis of price-making forces under price support is given by Gordon A. King, "Some Economic Effects of Supporting Feed Grain Prices," *Journal of Farm Economics*, Dec. 1956.

[31] Far reaching are the effects of reservation demand for feed via price support. Brandow observes that ". . . the loan program for corn . . . may have changed the alternatives available to corn-hog producers in such a way that they would feed corn to hogs only in the expectation of a slightly more favorable price for hogs than before." G. E. Brandow, *op. cit.*

[32] That reservation pricing is not exclusively a theoretician's devisal is borne out by a report from L. E. Fouraker and W. A. Lee: "The industry seemed to have all the institutional characteristics of competition, (yet) not one of the growers thought he could normally sell all of his stock of fruit at one moment of time at the market price. Nor did the buyers think they could purchase an abnormally large amount of fruit at the market price. All of the growers distributed their harvest over the season in some orderly fashion." "Competition and Kinked Functions in the Marketing of Perishables," *Southern Economics Journal*, Jan. 1956, p. 367.

equally appropriate, though less demonstrable statistically, to the release into the market of any product ready or nearly ready for sale. The difference between long-storable and briefly-storable commodities is only one of degree. Steers on feed, for instance, can be sold at various times within a range of several weeks. Further, the principle of reservation demand is allied with the notion of bargaining power in resolving price determination in direct sale of fed steers, inasmuch as the bargaining strength of the seller is related to the urgency of his selling. Will a livestock feeder let his steers go to a packer buyer at the same price—will his reservation demand be the same—irrespective of whether (a) he is overdue on loans from a bank or (b) he owns the bank? Certainly not. He'll bargain more weakly or strongly too; according to whether his stock are over-fed, and about to lose bloom, or still underfinished and capable of further feeding.

Reservation demand explains why, to the perplexity of many theorists, livestock producers persist in selling more and more of their livestock direct to packers instead of through central terminal markets. By textbook criteria, the central market comes far closer to the idealized perfect competition than does direct selling. Are producers that thoughtless?

Most assuredly they are not. Producers know that livestock once committed to a terminal market can be withdrawn and returned to the farm only at great cost to them. Practically, the committal is almost irrevocable. There is little reservation demand on their part, for it is limited to that derived from the commission man's appraisal of the position of potential buyers, the "feel" of the market. Back on the farm where livestock never leave the feed trough during direct purchase negotiations, reservation demand is readily effected. Geoffrey Shepherd touched on this point obliquely in asserting that a producer is ". . . in a stronger position with (his) hogs on (his) farm than if they were at a distant public market where they have to be sold within 1 or 2 days."[33, 34, 35]

Reservation demand bears also on the policy issue of direct payments to farmers in support of prices or income. The proposal for direct pay-

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[33] Geoffrey Shepherd, "Changes in Structure," *Marketing, Yearbook of Agriculture*, 1954, U. S. Dept. Agr., p. 57.

[34] An old English law against forestalling, regrating and engrossing in effect supported central market selling, for it prohibited sale of farm products before they reached the market, fair, or port. But the ban was against the *buyer*, and the aim was to protect the *consumer* against *higher* prices.

[35] This is not to suggest a position of the author in the direct-sale, central-market tug of war. The above seeks to explain why producers act as they do, not to indicate whether they are justified in their actions.

This does suggest, though, why both the actual practice of direct selling, and bargain theories of price, have most currency at times of big supply and low prices, while central markets, and Austrian marginal utility, are most popular during comparative scarcity.

ments has been built up and rationalized, if it did not indeed originate, with professional economists. Their logic has called for uniform payment rates to all producers as determined by the difference between national average prices received and the support price. There would be no guarantee that each producer would get the support price for his particular marketings. This latter system, it is said, would weaken the farmers' urge to bargain competitively, thereby reducing the market price and increasing the size of payment and the cost to government and creating a bonanza for middlemen. In the procedure proposed wherein the farmer's payment would be unrelated to the effectiveness of his own bargaining, that effectiveness would not be altered. He would have as much incentive to fight for the last dollar as if there were no payment program. So goes the rationale.

Perhaps it is right. Or perhaps it is not. Possibly we are once again trusting too much in the efficiency of generalized price-making forces. The present author does not know the answer, but insists there is a valid question that could be of much import to future price support policy. In the direct payment program for wool, which affords economists a laboratory test worthy of their study, for each dollar a producer obtained from sale of his 1955-crop wool he received 45 cents additional from the government. When a producer knows that whatever price he negotiates may be enhanced by almost half without effort on his part, will he bargain as persuasively as he would under grimmer circumstances of the immediate price being the total receipt? Even though the program's provision for payments based on *percent* of realized price rather than a payment rate per pound is a safeguard, the question remains, loaded with implications.

Finally, reservation demand is a conceptual tool to apply to the milieu or setting for pricing of various farm products at successive stages of marketing. Bargaining power is greater, and reservation demand more applicable, for a storable than a perishable commodity. More significant is the relative perishability at successive stages of marketing and processing. Once more livestock afford an example. Livestock are perishable, particularly after they have left the farm. Carcass meat and fresh meat are too. Fresh meat must be sold at retail within about 10 days after it is received, and the season-to-season storage of beef and pork, a costly operation, is small relative to total production. Here, in fact, may be a case where the farmer is in a stronger position than his customers, for livestock for market can probably be held back longer at the farm than meat can be held at wholesale or retail. The perishability of fresh meat keeps market pricing of livestock and meat fluid and reasonably competitive. This may be a partial reason why livestock pricing has been satisfactory enough to producers to preclude a universal clamor for price support, and certainly a reason that profit statements of meat packers show modest earnings compared with many food and nonfood trades.

Let another development enter that would revolutionize the meat trade but create little change in such aggregate price-making measures as total annual meat output or consumption. The change will thereby remain outside the compass of conventional equilibrium price analysis. The innovation would be to eliminate perishability of fresh meat either by frozen distribution of prefabricated cuts or by irradiation. The latter is probably the more promising, as it offers more chance of lower costs. Perfection and widespread adoption of either would overturn the present competitive relation between producer and marketer. Perishability would disappear for the marketer, and would be a millstone about the neck of the producer. Let no one think pricing of livestock would be unaffected! In the judgment of this writer, the result might be to bring to the livestock industry some version of the marketing methods now practiced for that other class of farm products sold perishable at the farm and converted to imperishability by the processor, namely, fruits and vegetables for processing. Contractual arrangements of various sorts years ago replaced free-market pricing for most of those crops. They might conceivably do so for a sizeable part of the livestock sold for slaughter.

Price Analysis at Successive Marketing Stages

Farmers seldom any longer sell direct to the consumer. Yet price analysis, true to its Austrian school antecedents, continues to focus chiefly on the retail or consumer level. This tendency, like others reported here, has had illustrious critics. Professor Taussig did not overlook the point. "Possibly (I say possibly!) there would be less uncertainty if all sales were to 'ultimate' consumers. . . . The transactions on the market, however, are largely between . . . middlemen. . . ."[36] T. W. Schulz has asked for analyses of pricing at intermediate levels: "The demand for stocks . . . i.e., for private stocks held by traders, processors, consumers in wardrobes and food lockers, withheld by farmers, and for public stocks held by the CCC and other governmental agencies . . . is bound not only by price, income and population but also by other complex circumstances which at times appear to shift the demand schedule of farm products about in a perverse manner." In a footnote he explains that the demand schedule he refers to is that which "confronts farmers at the point at which they sell their products."[37]

By instruction of Congress, statistical work in USDA on marketing margins for farm products has been expanded recently. Apparently some economists find it impossible to be sympathetic. However adequate margin data may or may not be for measuring either competitive advantages

[36] Taussig, *op. cit.*, p. 399. The parenthetical note is his.

[37] T. W. Schultz, "Instability of Farm Prices Reconsidered," *Journal of Farm Economics*, December 1954, p. 779.

or efficiency among marketers, they do provide a basal statistic for price analysts. For the bearing of consumer-level pricing on pricing at the farm is directly related to the size of the marketing margin relative to the net return to farmers. There is a tremendous difference between farm pricing of eggs, for which 69 percent of the retail price is returned to the farmer, and of peaches for canning, which return only 18 percent.

Most analysts have bowed down in frustration before the complexities of analysis of prices at successive levels, or of the size of marketing margins, which is the same thing. Usually constant margins are assumed, attention being given only to whether constancy is in cents per unit or percent. Even the profusion of equations on the feed-livestock economy by Hildreth and Jarrett includes only values for "presumptions" of constant dollar or constant percentage margins, or combinations of the two.[28]

For the majority of commodities and all farm-produced foods as a whole, marketing margins exceed the returns to farmers. The margin took 60 cents of the consumer's total food dollar in 1956 and the farmer's share was only 40 cents.

Moreover, while the constancy or slow trend in margins so often assumed may be true over a number of years, it does not hold within short time periods—at least not for commodities still subject to a sizeable degree of competitive pricing. The following are the ranges of quarterly margins for selected foods in the 15 quarters from January-March 1953 to July-September 1956, in cents per pound (except eggs, which are cents per dozen):

Beef	22.3-27.9	Sweetpotatoes	7.2-11.0
Pork	19.4-25.8	Tomatoes, fresh	12.9-22.9
Chickens, frying	18.0-21.5	Navy beans	8.5-10.4
Eggs	17.1-20.1	Salad dressing	25.5-28.3
Beans, green	9-7-18.5	Vegetable shortening	16.6-22.6
Potatoes	3.2- 5.5		

Significant also are such annual margins as those calculated by AMS as the difference between price received by farmers for oilseeds and the wholesale value of products. From 1947 to 1955 these ranged as follows:

Soybeans	17-85 cents per bushel
Cottonseed	17-50 dollars per ton
Flaxseed	24-80 cents per bushel

The bearing of changing margins to strictly short-term swings in prices of hogs and cattle was highlighted in two reports by AMS in early 1956. With respect to hogs, "It appears that $2.50 of the $9.00 decline in prices of live hogs at Chicago from June to December 1955 was accounted for

[28] Clifford Hildreth and F. G. Jarrett, *A Statistical Study of Livestock Production and Marketing*, 1955, pp. 110-111.

by the failure of retail pork prices to fall as rapidly as farm prices of hogs."[39] For beef the indictment of margins was even more severe: "About 60 percent of the $4.15 per 100 pounds decline in farm prices for U.S. Choice grade cattle which took place from the first quarter of 1955 to the fourth quarter was associated with a widening of marketing margins."[40]

Forty-three percent of the variation in quarterly average prices of Choice cattle from 1953 to mid-1956 was accounted for by varying marketing margins, and 57 percent by fluctuations in retail price of beef. For hogs, for which overall price swings have been extreme, the relative role of margins is less: They amounted to 20 percent of the change in hog prices.

In principle, margins for marketing farm-food products are subject to three influences: changes in cost rates to marketing agencies (labor, packaging materials, etc.); amount of processing and services rendered; and volume of products handled. The significance of each varies according to length of time period, and by product. With effective competition, and without technological changes in processing or in services rendered, over the longer run average margins would be expected to run parallel to trends in costs. Margins for meat conform to this rule; a time series of annual margins can be explained more closely by the consumers' price index than by any other measures or factors.[41]

In the short run, however, margins for various commodities will be found to behave in various ways. Margins for soybeans, as an illustration, have trended downward the last 10 years. They display, moreover, some tendency to be larger in individual years of reduced production. Replacement of old screw-process extraction with more efficient solvent extraction and construction of added capacity have been a factor. The nature of competition (or lack of it) could also enter in.

For livestock and meat, on the other hand, margins have not only trended upward in past years but have exhibited a persistent short-run tendency to widen when supplies increase and narrow when supplies decrease—a direction of movement that adds to instability of prices to farmers and that may account for the interest of Congress in the performance of "middlemen" in a year such as 1955. The chart that follows correlates quarter-to-quarter changes in consumption of pork per person and the deflated margin. That for beef, not reproduced here, is similar. Some of the charted regressions are statistically significant and some are not, but all are positive in slope. *The greater the increase in supply, the*

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[39] *Pork Marketing Margins and Costs,* U. S. Dept. Agr. Misc. Publ. 711, April 1956, p. 4.

[40] *Beef Marketing Margins and Costs,* U. S. Dept. Agr. Misc. Publ. 710, Feb. 1956, p. 3.

[41] Unpublished analysis by the author.

wider the margin. Conversely, the more supply decreases, the more margins shrink. Far from being constant in either dollars-and-cents or percent, marketing margins for meat fluctuate greatly in the short run according to the rate of change in market supplies of livestock.

Sometimes, as in December 1955, the supply of livestock for slaughter taxes capacity and creates increasing costs. Usually, however, the explanation of wider margin for a large supply lies not in the pressing against

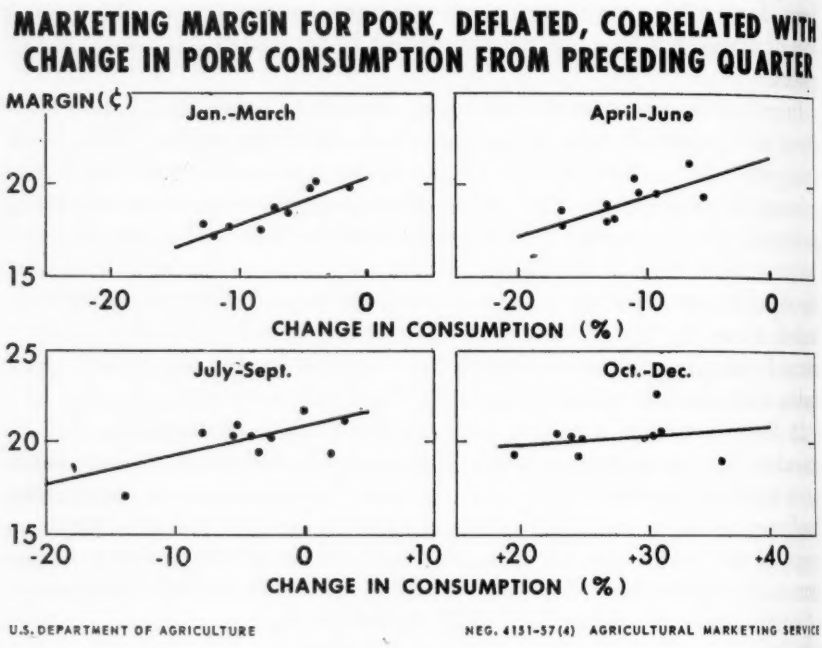

FIG. 3

limits of capacity but in the desire of the entire meat trade for stability in both prices and volume of business. Because of this desire, the trade resists any departure from normal supply that brings change in the bargaining positions between producer and marketer. When market supplies of hogs or cattle are small the meat packer will bid hard to get his regular quantity, the farmer finds himself in a favored position, and margins shrink. When marketings increase, the packer is reluctant to expand his kill and will do so only if prospective margins and profits are large. Margins not only narrow and widen, but change more than costs; and as a consequence, packers' profits move up and down radically. We find presidents of meat-packing firms presenting glowing annual reports on profits to their stockholders in a huge livestock supply year such as 1955, then

apologizing timidly in public and cracking the whip in private when profits taper later.[42]

Thus marketing margins for certain agricultural products are frequently susceptible to study, and any progress in that direction adds a great deal to our kit of tools for price analysis. Statistical analyses of livestock prices employed by the author begin with analyses of retail prices, follow with separate approximations of probable marketing margins (not an assumed constant margin), and end in a derived estimate of live animal prices. Depending on the circumstances, the separate equations may be fitted by least squares or may form part of a system of equations to be fitted simultaneously. Additional work along these lines is planned.

Limitations to Departures from Conventional Analyses

Now that a case has been made for introducing certain departures and modifications to conventional equilibrium price analysis and for taking more account of the institutional aspects of market pricing, an emphatic caveat is necessary. There is no occasion whatever for disregarding aggregative economic values in price analysis, or violating them in price policy. Within fairly broad limits they exert inviolable control over the affairs of men where price is concerned. Although we may wish to avoid the Scylla of over-trust in aggregative price analyses, the Charybdis of inattention to them is even more menacing. In the 1920's, a flouting of basic economic forces led to fiascos in commodity valorization schemes. In 1933 George N. Peek, first Administrator of the AAA, tried to increase tobacco prices painlessly through negotiations (marketing agreements) with tobacco processors, with production control held aside as a last resort.[43] His doctrine is not entirely at variance with some of the points made in this paper, or with the accepted theory of imperfect oligopoly, and the marketing agreement technique has since had some success in aiding price with a minimum of production control. But for the scale of price reform sought for tobacco in 1933, production control was soon proved essential.

As the marketing and pricing system changes, analysts will have to adjust therewith. Equilibrium analysts may resent the interference of government price support programs in their "models" and equations. Yet Meinken, in his study of wheat pricing, developed a model in which

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[42] 1955 was a year of generally high profits in meat packing. 1956, a year of transition in livestock supplies, found profit records less uniform but at least one major packer found the going to be rough. And by the first quarter of 1956-57, there was evidence of generally lower profits, with one packer lamenting that "we have been handicapped by a sharp decrease in hog marketings."

[43] Harold B. Rowe, *Tobacco Under the AAA*, 1935.

the influence of programs can readily be incorporated.[44] Now that government action has encroached to more farm commodities, the need for adapting analytical techniques is ever more urgent. For those commodities not under government price influence, the several other institutional elements in pricing must be recognized, lest scholars who interpret the behavior of market prices go too far astray.

[44] Kenneth W. Meinken, *The Demand and Price Structure for Wheat*, U. S. Dept. of Agr. Tech. Bul. 1136, Nov. 1955. Also relevant is Gordon King, *op. cit.*

LABOR MARKET EFFICIENCY FOR AGRICULTURAL PROCESSING*

GEORGE S. TOLLEY
North Carolina State College

THIS paper concerns the effectiveness with which markets allocate labor employed by firms processing agricultural products, chiefly food. Our measure of effectiveness is the extent to which such firms pay as great remuneration to any unit of labor as could be received for that labor in other parts of the economy. The measure has its origins in the observation that, if the condition just stated were fulfilled exactly, a presumption would exist that the marginal contribution of labor to real national output was equalized (and hence total contribution maximized) as between food processing and the rest of the economy.

In the first section we attempt to find out whether, within given labor market areas, persons of equal skill receive equal remuneration in food processing and in all manufacturing. In the second section we consider some evidence having to do with structural characteristics of food processing. This evidence permits us to take account of the effect of restricting the earnings comparisons to given areas, and it also provides an independent check on inferences suggested by the earnings comparisons.

I. *Earnings Comparisons*

The 1950 Census: Analysis of Variance. From the 1950 Census, earnings data are available for 1949 for persons in two occupational classifications, laborers and operatives, by major industrial classification.[1] Table 1 shows median incomes in fourteen states in food processing and in all manufacturing.[2] For *laborers,* earnings are higher in manufacturing in seven of the fourteen cases. This is exactly what one would expect if there is no tendency for earnings to differ between manufacturing and food processing. For *operatives,* however, earnings are higher in manufacturing in twelve of the fourteen cases. For operatives in this sample of states, a significant difference in earnings between manufacturing and food processing might be indicated.

Table 1 has been presented chiefly for purposes of illustration. Although a comparison within a given state eliminates regional differentials,

* For aid of various kinds in preparing this paper, thanks are due to: Richard Ablin, O. H. Brownlee, Margaret Cooper, W. F. Finner, Clair Friedland, Vaughn Hastings, D. Gale Johnson, T. C. Koopmans, H. Gregg Lewis, T. W. Schultz, and Seymour Smidt.

[1] The two occupations account for the majority of employment in food processing.

[2] This sample was chosen to obtain the two states which account for the largest amount of employment in food processing in various areas of the country.

TABLE 1. MEDIAN INCOME OF MALES, SELECTED GROUPINGS, 1949

State	Laborers		Operatives	
	All manufacturing	Food and Kindred	All Manufacturing	Food and Kindred
Connecticut	$2,328	$2,369	$2,669	$2,469
Massachusetts	2,222	2,304	2,487	2,487
New York	2,452	2,572	2,747	2,713
Pennsylvania	2,381	2,329	2,697	2,532
Illinois	2,508	2,541	2,913	2,871
Ohio	2,411	2,321	2,936	2,770
Kansas	2,313	2,325	2,778	2,557
Nebraska	2,302	2,372	2,583	2,622
Alabama	1,558	1,311	2,013	1,637
Georgia	1,297	1,409	1,775	1,592
Oklahoma	2,050	1,801	2,482	2,132
Texas	1,833	1,617	2,490	1,990
California	2,482	2,272	2,997	2,814
Washington	2,641	2,522	3,102	2,968

Source: U. S. Bureau of the Census, *U. S. Census of Population: 1950*, P-C Series (Washington: Government Printing Office, 1953), Table 78.

a comparison within a given metropolitan area eliminates community-size differentials, as well as virtually all other kinds of locational differentials. Data for standard metropolitan areas would appear for this reason to be superior to the state data for use in making statistical tests in the present study. In order to undertake an analysis of variance, the seventy-six standard metropolitan areas were grouped into fifteen regions.[3] The industrial grouping was the two-fold grouping of food and kindred versus all manufacturing. For *laborers*, the regional classification accounts for 60.2 per cent of the variation and the industrial classification for 0.2 per cent, with 39.6 per cent unexplained. For regions, the value of F is 12.60, significant at the .001 level. For industries, the value of F is 0.45, not statistically significant. In following the same procedure with earnings of *operatives*, the regional classification accounts for 50.1 per cent of the variation and the industrial classification for 2.6 per cent, with 47.3 per cent unexplained. For regions, the value of F is 9.85, significant at the .001 level. For industries, the value of F is 7.25, significant at the .01 level.[4,5]

[3] (1) Connecticut, Rhode Island; (2) Massachusetts; (3) New York; (4) Pennsylvania; (5) Delaware, Maryland, Virginia, West Virginia; (6) Georgia, Florida, Alabama; (7) Kentucky, Tennessee; (8) Louisiana, Oklahoma, Texas; (9) Ohio; (10) Michigan; (11) Illinois, Indiana; (12) Wisconsin, Minnesota; (13) Colorado, Utah; (14) Arizona, California; (15) Oregon, Washington.

[4] The statistical significance of the industrial classification for operatives is apparently due to areas hiring relatively few food and kindred employees. This is revealed by the nonsignificant F value obtained when these areas are excluded. When areas with less than five hundred operatives employed in food and kindred are excluded, the results are a value of F for the regional classification (10.38) signif-

Statistically significant values of F for the regional classification merely indicate the desirability of our procedure of making earnings comparisons at given locations. They only verify the already well-known tendency for wages to vary geographically. The industrial classification rather than the regional classification is of main pertinence to this study. If the industrial classification is significant, chance factors cannot account for earnings differences between food and manufacturing. This result would indicate a persistent tendency for persons in a given occupational group to receive different remuneration in food than in manufacturing. The industrial classification thus provides a test of labor market efficiency. The preceding paragraph indicates that, utilizing data for laborers, there is no tendency toward different remuneration between food and manufacturing; whereas a significant difference is indicated for operatives.

The 1950 Census: Further Considerations. The average difference for operatives as between food and manufacturing within a given metropolitan area is 5 per cent. With a yearly income of $2,500, this amounts to $125, or perhaps a little more than 6 cents an hour in terms of wage differential. On the other hand, while the difference as just viewed may appear small, the capitalized value even at the high interest rate of 10 per cent is $1,250. One might think that a payment of $1,250 would be enough to induce substantial labor movement.

The differences in earnings are probably not so large as to rule out the possibility that they are due to skill differences within the occupational classifications. That is, they might be due to the fact that occupational classifications do not actually contain labor of completely homogeneous skill, so that the earnings difference might be due to operatives in food being less skilled than operatives in manufacturing. But in the absence of a reason definitely suggesting this assumption, we deem it advisable to investigate the differences in earnings further.

The frequency distributions in Figure 1 are for earnings in each industry as a percentage of earnings in all manufacturing in the seventy-

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icant at the .001 level and a value of F for the industrial classification (2.27) not statistically significant. One possible explanation of this result is that the areas with few operatives in food are those characterized by small plants. Small plants generally have low wages. We conjecture that the areas of few employees for any industry might for this reason tend to compare unfavorably with all manufacturing in that area.

[5] The magnitude of the industrial differences is substantially reduced in making comparisons by metropolitan areas instead of by states. Earnings of operatives in each of the forty-eight states are on the average about 10 per cent higher in all manufacturing than in food and kindred. Within the seventy-six metropolitan areas, on the other hand, they are on the average only about 5 per cent higher. The indication may therefore be that a part of the differences observable in the state comparisons is, in fact, attributable to the differing concentration with respect to community-size between food and all manufacturing.

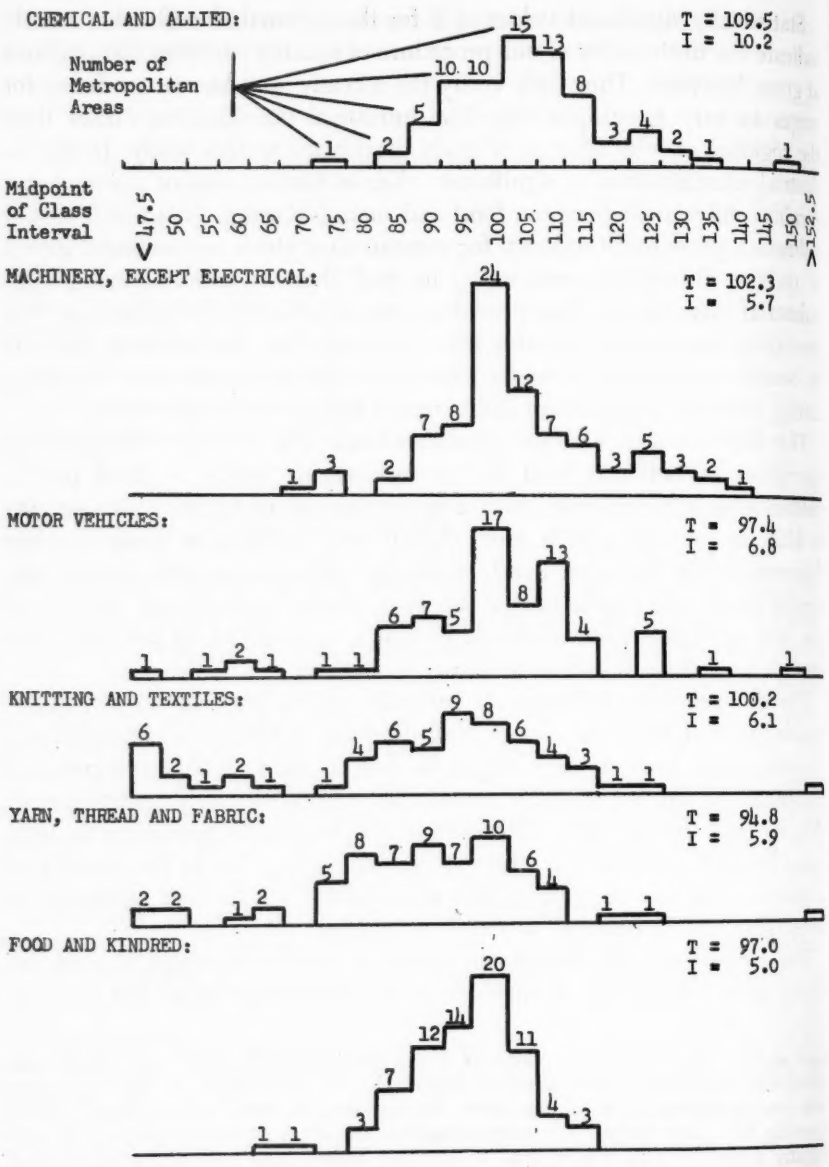

FIG. 1. MEDIAN INCOME IN SELECTED INDUSTRY GROUPS AS A PERCENTAGE OF MEDIAN INCOME IN ALL MANUFACTURING, MALE OPERATIVES, 1949.

six standard metropolitan areas.[6] If operatives in each industry earned the same as operatives in manufacturing as a whole in a given metro-

[6] Figure 1 utilizes data on manufacturing industries as given in *U. S. Bureau of the Census, U. S. Census of Population: 1950*, P-C Series (Washington: Government Printing Office, 1953), Table 78.

politan area, the 76 observations for each of the frequency distributions would all fall in the class interval whose midpoint is 100. The modal class interval for four of the six industries is the one whose midpoint is in fact 100, and food and kindred skews somewhat to the left—that is, it appears to contain a disproportionate number of areas where earnings are lower than in all manufacturing. However, at least two of the other industries are much more marked in this characteristic. These are knitting and textiles, and yarn, thread and fabric.

To permit a precise comparison, the coefficients T and I have been computed for each industry group. These are shown in Figure 1.[7] Consider first the coefficient T, which is an indicator of the tendency for earnings in each industry to differ from earnings in all manufacturing. It is a weighted average of the earnings percentages on which the frequency distributions are based, each percentage being weighted by the proportion of employees receiving that percentage. The "ideal" value of this coefficient would be 100. The weighting procedure takes account of the quantitative importance of earnings inequalities in the various areas.[8] As might be expected, the value of T for food processing indicates that

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[7] Let n_{ij} refer to the number of employees in the i^{th} industry and j^{th} area and let r_{ij} refer to the ratio of earnings in that industry and area to earnings in all manufacturing in the area. Then

$$T_i = \frac{\sum^{j} r_{ij} n_{ij}}{\sum^{j} n_{ij}} \cdot 100,$$

$$I_i = \frac{\sum^{j} \left| (r_{ij} - 1) n_{ij} \right|}{\sum^{j} n_{ij}} \cdot 100.$$

It is apparent that T is a measure of the central tendency in earnings ratios and I is a measure of their dispersion. In both, observations are weighted by the number of employees. The measure of dispersion, however, is not a usual one. First, the deviations are taken around the "ideal" ratio of 1 rather than around a measure of the central tendency of the distribution (such as T). Second, I is simply the mean deviation instead of the square root of the mean squared deviation. These procedures are followed in order to obtain from the data a maximum amount of information of economic significance. Taking deviations from the "ideal" ratio enables I to be interpreted as a measure of the total amount of inefficiency which may characterize the use of labor in an industry. The use of weights and of actual rather than squared deviations permits an interpretation in terms of labor movement which might occur if earnings were equalized, as is discussed in footnotes 8 and 10.

[8] If earnings in a given industry were made the same as in all manufacturing for each metropolitan area, a contraction of employment could be expected to occur where this entailed a rise in earnings, and an expansion where it entailed a fall in earnings. If the elasticity of demand for labor were unity, the deviation of the value of T for an industry from 100 would indicate the percentage change in

earnings are lower than in all manufacturing. However, food and kindred ranks fourth among the six industries with respect to tendency of earnings equality with all manufacturing, and—more important—numerically it is extremely close to that of the second and third ranking industries.[9]

The I coefficients measure the total amount of inequality in earnings which characterizes each industry group, disregarding the central tendency of earnings as indicated by such a measure as T. The value of I is the sum of the departures from 100 in each area weighted by employment and taken without regard to sign. That is, it is the absolute rather than the algebraic sum of these departures. The "ideal" value of this coefficient would be zero, since the ideal situation calls for no departures from 100. This coefficient is particularly useful in enabling a check on the degree to which the central tendency may conceal a wide dispersion of both high- and low-paying situations.[10] As can be seen from Figure 1, the value of I for food and kindred is the most favorable of any of the six industry groups.[11] However, most of the coefficients are similar, and only chemical and allied would seem to be characterized by a substantially higher total amount of inequality.

These further considerations relating to the 1950 Census suggest either (1) there are significant differences in skill among workers classified as operatives, or (2) there is a significant amount of earnings inequality among workers of equal skill, *which does not however impinge more*

employment which might be expected for the industry as a whole when earnings were equalized. One could then say, for instance, that there appears to be 3 per cent "too much" employment in food processing. This statement seems helpful in gaining a perspective on the possible quantitative importance of observed differences in earnings though the assumptions underlying this statement are admittedly crude.

[9] The ranking is according to departure of T from 100.

[10] Let us pursue the reasoning in footnote 8. The I coefficient might be considered as a measure of the total amount of labor transfer which would result from making earnings in an industry the same as in all manufacturing for each area. By retaining the previous assumptions and again using food and kindred as an example, the following adjustments could be visualized: The industry's employment would decrease by 4 per cent as a result of contractions in areas where food and kindred earnings had been relatively low, and it would expand by one per cent as a result of expansions in areas where earnings had been relatively high. Thus, the net out-movement of 3 per cent as revealed by T is seen to conceal possible transfers within the industry which would be called for under the assumptions which have been made. The restrictive nature of the assumptions may again be emphasized. Equalization of earnings would not necessarily leave median earnings in all manufacturing unaffected. Further, labor flows among industries might change relative prices of the products of the industries and thus entail shifts of the demand for labor as well as movements along the schedule. The assumption of unit elasticity of demand for labor is of course arbitrary. However, if the elasticity for each firm is identical, the measures may still be good indicators of labor movement in relative terms which would be required and hence would suit well enough the purposes of the present study.

[11] A favorable I is one close to zero.

severely on food processing than on other industries.[12] The fact that all industries have a dispersion of high and low earnings, as indicated by the I coefficients, regardless of their average earnings may hint that differences in skill are present. If this possibility could be ruled out, it would mean that food processing is involved in earnings inequality for labor of equal skill—within the industry as well as vis-a-vis the rest of manufacturing. But the more important conclusion is that we apparently would find no higher degree of labor market efficiency for any other manufacturing industry than we find for food processing.[13,14]

The 1947 Census. The main evidence pertaining to earnings has now been presented. Data from the 1947 Census of Manufacturers provide a much weaker test of labor market efficiency because they do not permit comparisons of earnings of workers who might be expected to have equal skill. The additional evidence can nonetheless make a contribution in strengthening or weakening our degree of belief in the conclusions we have reached.

In attempting to utilize these data, consider an economy in which the firms of each industry, regardless of their location, hire identical proportions of different kinds of labor. Locational wage differentials could be consistent with economic efficiency due, say, to differences in cost of living. The "ideal" situation would then be one where the difference in average earnings between any two industries in one region would be exactly equal to the difference between these two industries in any other

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[12] Or partly both.

[13] A study of the 1940 Census was also carried out, and it is corroborative of the results that have been reported for the 1950 Census. The analysis of variance, in fact, showed no significant divergences and thus offers stronger support of the conclusions just stated.

[14] The conclusions of the study rest heavily on the census data analyzed in the two preceding sections. Let us briefly comment on the adequacy of these data. Perhaps their worst shortcoming for our purposes is that they include nonwage and nonsalary income which ought to be excluded in this study pertaining to the human factor of production. Our hopes are 1) that property-type income may not be very important among operatives and laborers and 2) that for these groups such income may be distributed fairly equally among industries. Another shortcoming of the data is possible crudity of the skill classification. This, too, may not be very serious if it impinges equally among industries. Another objection that might be raised against the data is that persons classified in the food industries may often have wage or salary income from other industries. (See footnote 34.) However, it would seem that the data are desirable rather than undesirable in having this characteristic. We come nearer to gaining valid comparisons of labor product if we measure total wage and salary income. Still another possible shortcoming of the data is that earnings are not adjusted for hours worked during the year. One ramification is that in some cases we should add to earnings which are associated with little work the value of extra leisure. The view in this study is that in the absence of reasons strongly suggesting a misleading bias as between industries, such complications are safely ignored. See footnote 18 for an instance where hours of work are not ignored.

TABLE 2. STATISTICAL ANALYSES OF AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS, 1947*

Industry Group	Industrial Differential (Dollars)	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
		Regional Differential (Dollars)								
		+.004	+.104	+.076	−.005	−.131	−.144	−.197	+.033	+.261
		Residuals (Dollars)								
Meat Packing	+.202	+.027	−.050	+.026	+.088	−.062	−.036	+.053	−.012	−.035
Prepared Meats	+.111	+.009	+.038	+.034	+.129	−.025	−.025	−.065	−.057	−.037
Poultry Dressing	−.191	++.119	++.003	−.093	−.061	++.032	++.024	+.071	+.048	−.146
Concentrated Milk	−.010	−.126	−.095	+.017	−.126	++.133	++.100	++.039	−.025	+.080
Ice Cream and Ices	−.037	++.029	++.048	−.033	+.094	++.026	−.016	−.029	−.089	−.030
Canning and Preserving	−.148	−.004	++.062	+.030	−.075	++.004	−.030	−.090	−.001	+.107
Bottled Soft Drinks	−.053	−.003	++.004	−.030	−.041	−.026	−.088	+.015	−.035	++.160
Flavorings	+.186	−.165	−.049	−.063	−.023	−.017	+.154	++.012	+.188	−.039
Manufactured Ices	−.059	+.112	+.001	+.108	+.012	−.064	−.085	−.005	−.022	−.061

* The original data were obtained from U. S. Bureau of the Census, *Biennial Census of Manufactures: 1947*, Vol. II (Washington: Government Printing Office, 1949), pp. 66–146. The calculations are described in the text.

region. Departures from this perfect pattern would suggest labor transfers that would increase real national product.

Table 2 shows the results of using data on average earnings from processing industries to estimate regional and industrial differentials.[15] In the ideal situation just described, all the residuals would be zero. For the nine food-processing industries shown in Table 2, about 42 per cent of the variation is attributable to industrial differentials and about 45 per cent to regional differentials. In other words, about 87 per cent of the variation is accounted for by industrial and regional differentials and about 13 per cent is unexplained, or residual. Since the residual variation is small in relation to the industrial and regional variation, these data appear consistent with the hypothesis that there are few labor market inefficiencies.[16]

The trend of earnings in food processing and total manufacturing. The final earnings evidence is presented in Figure 2, which shows ratios of earnings indexes in food and total manufacturing during the past three decades.

If there were significant immobilities connected with the food industries, there would be no necessity for wages to move similarly to those in the rest of the economy. As demand and supply conditions changed, labor

[15] When earnings are classified in columns by regions and in rows by industries, the difference between the means of two columns gives an estimate of the locational differential between the two regions, and the difference between the means of two rows gives an estimate of the differential between the two industries.

To illustrate how to read Table 2, actual average earnings in prepared meats in the Middle Atlantic Region are $1.246 per hour. Adding the industrial and regional differentials for this cell ($.111 and $.104) to the national average $.993, we obtain predicted earnings of $1.208. The difference between actual earnings and earnings predicted by this estimation, or $0.038, is the entry in the cell in question.

[16] One reason the test is of limited power is that the estimation of industrial and regional differentials from these data is such as to minimize the residual variation. That is, the effect of deviations in particular cells are reflected in the estimates and their residual effect minimized. Hence, the possibility arises that some of this explained variation is associated with labor market inefficiencies. In particular, one may have difficulty in believing that some of the substantial locational differentials, such as 45.8 cents between the Pacific Region and the West South Central Region, could be associated with an efficient set of circumstances. To the extent that the data are consistent with the existence of substantial inefficiencies, some information is revealed about them, namely that if they exist, they are primarily industry-connected or region-connected. That is, the economy does not appear to be riddled with isolated cases of inefficiency, with wages in one industry and region determined independently of those in others; for, if this were the situation, the residual variation could be expected to predominate over the explained variation.

More important for the present study than the locational differentials are the industrial differentials. If the industrial differentials are associated with inefficiencies, it cannot be denied that their magnitude is sizable and that, in this event, substantial labor market inefficiency for food processing would be indicated. Only a more thorough study of labor requirements of industries, requiring information not readily available, would enable one to tell whether the differences might be due to skills.

would not move at all to equalize wages or would move very slowly. Divergences in the trend of wages would therefore arise. If, on the other hand, labor were highly mobile, no divergence in the trend would be expected, for labor flows would quickly wipe out any temporary differentials resulting from changes in demand and supply.

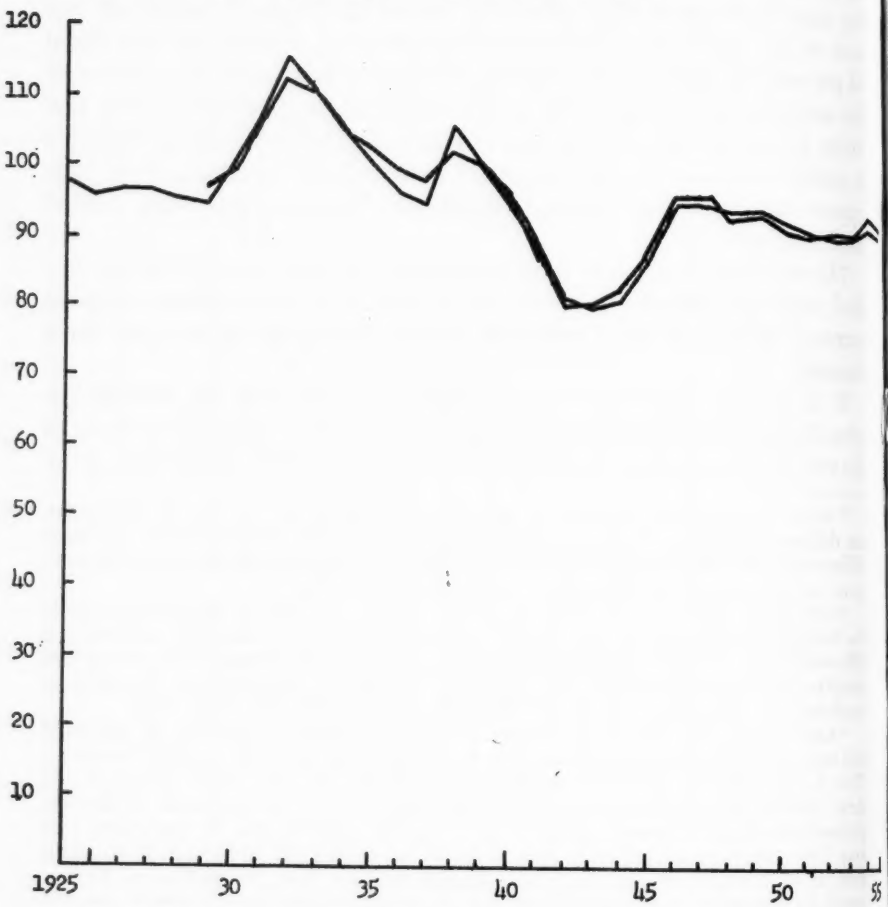

FIG. 2. RATIOS OF INDEXES OF EARNINGS IN FOOD AND KINDRED TO EARNINGS IN ALL MANUFACTURING.

Figure 2 indicates that, except for years of depression and the war years, wages in food and total manufacturing have moved very closely together.[17] From the beginning to the end of the period for which data

[17] Information was pieced together from several series as follows: Indexes of employment and payrolls for 1924-1941 from U. S. Department of Commerce, *Statistical Abstract of the United States, 1942* (Washington, Government Printing Office, 1943), p. 389, p. 391; average annual earnings per full-time employee for 1929-1953 from U. S. Department of Commerce, *National Income, 1954 Edition*

are available, the general level of money wages more than doubled. The ratio, as shown in the figure, exhibits much more stability than the level of wages; and the value of the ratio at the end of the period is very close to its value at the beginning.[18]

II. *Bearing of Structural Data on the Efficiency Hypothesis*

The location of food processing. The earnings comparisons above indicate as much labor market efficiency for food processing as for the rest of manufacturing. However, the major evidence on earnings was restricted to comparisons within given areas. In view of this incompleteness we now ask: What are the locational characteristics of food processing, and how can reference to them help to test further for labor market efficiency?

Even though efficiency is indicated for given labor market areas, there might be a nonoptimal distribution of labor between food processing and the rest of the economy for the following reason. Food processing might tend to be concentrated in areas of excessively low or high wage rates. Concentration in areas of excessively low wage rates would suggest there was more labor devoted to food processing than is consistent with maximization of real national output; greater output could be achieved if workers with low marginal products in food processing were transferred to other industries. (The example would be converse if concentration were in areas of excessively high wage rates.) On the other hand, if there were no relative concentration, i.e., if food processing tends to be located similarly to other economic activity, the existence of excessively low or high wage rates geographically might not greatly affect the distribution of labor as between food processing and the rest of the economy. The expansive effect of low wages on employment and the contractive effect of high wages might then be about the same for both food and the rest of the economy.

(Washington: Government Printing Office, 1954), pp. 200-201 and for 1954-1955 from U. S. Department of Commerce *Survey of Current Business,* Vol. 36, No. 7 (July 1956), p. 20; weekly earnings of production workers for 1939-1954 from National Industrial Conference Board, *The Economic Almanac 1956* (New York: Thomas Y. Crowell Company, 1956), p. 247, p. 249, and p. 251 and for 1955 from U. S. Department of Labor, *Employment and Earnings,* Vol. 2, No. 12 (June 1956), p. 104.

[18] Because the output of nonfood products declined more than that of food products during the great depression, employment undoubtedly declined more in the nonfood industries. Part of this decline may well have been in hours as well as in numbers of employees. During the war, there was no doubt more overtime in industries directly related to armaments output than in the food industries. The two periods, the worst years of the depression and the war years, were unusual. It therefore seems best to disregard them in the present study. When there is widespread unemployment, the labor market is probably not efficient, since seniority and other arrangements not necessarily related to efficiency may be predominant in determining employment. During the war, there was a tendency for wages to be kept high in industries important for war in order to ensure an adequate labor supply.

TABLE 3. SELECTED INDUSTRY GROUPS AS A PERCENTAGE OF ALL MANUFACTURING, FOR THE EXPERIENCED LABOR FORCE, THE U. S. AND REGIONS, 1950

Industry	United States	North-east	North Central	South	West
Food and kindred	9.72	6.73	10.80	10.68	15.79
Meat products	1.86	.67	3.11	1.90	1.95
Dairy products	1.09	.73	1.44	.93	1.62
Canning	1.15	.66	.57	1.33	5.04
Grain-mill products	.79	.32	1.09	1.04	1.00
Baking products	1.86	1.79	1.70	1.99	2.45
Confectionary	.55	.72	.50	.33	.53
Beverage	1.37	1.04	1.44	1.80	1.51
Miscellaneous	.79	.53	.67	1.18	1.38
Not specified	.26	.27	.29	.17	.30

Source: U. S. Bureau of the Census, *U. S. Census of Population, 1950* P-C Series (Washington: Government Printing Office, 1953), Tables 130 and 160. In manufacturing, the experienced labor force is 15,187,852 for the U. S.; 5,565,514 for the Northeast; 5,159,723 for the North Central; 3,132,308 for the South; and 1,330,307 for the West.

It would be useful to know the extent to which geographical differences in wages are in fact excessive.[19] There is apparently no satisfactory answer to this question yet, and we cannot pursue it in the present study. Geographical differences in wages are large.[20] Let us conjecture in this study that they may sometimes be excessive[21] and see, if so, what is the effect of the location of food processing.

Table 3 indicates that there is a strong similarity among regions in the concentration of manufacturing and of food. Food accounts for roughly ten per cent of manufacturing in the country as a whole, and this percentage is reflected almost exactly for the North Central and the South. Since the Northeast is not an area of either extremely high or low wages, its relative lack of food processing may imply little deviation from the

[19] An excessive wage difference might be defined as one where geographical movement would increase real returns to labor of given skill. The excessive difference would be negative if due to so-called cost-of-living factors a widening of observed wage difference were necessary to equate real returns.

[20] For a manifestation in the data we are considering, see Table 1 and the column differences for Table 2. Some literature is: John P. Henderson, "An Intercity Comparison of Differentials in Earnings and the City Worker's Cost of Living," *Review of Economics and Statistics*, Vol. XXXVII, No. 4 (November 1955), pp. 407-411; D. Gale Johnson, "Some Effects of Region, Community Size, Color, and Occupation on Family and Individual Income," *Studies in Income and Wealth, Volume 15* (New York: National Bureau of Economic Research, 1952), pp. 49-63; Richard A. Lester, "Reflections on the 'Labor Monopoly' Issue," *Journal of Political Economy*, Vol. LV, No. 6 (December 1947), pp. 513-536. National Industrial Conference Board, *Differentials in Industrial Wages and Hours in the United States, Study Number 238* (New York: National Industrial Conference Board, Inc., 1938); Henry M. Oliver, "Income, Region, Community Sizze and Color," *Quarterly Journal of Economics*, Vol. LX, No. 3 (August 1946), pp. 588-599. United Packinghouse Workers of America, *Geographical Wage Rate Differentials in the Meat Packing Industry* (Chicago: Champlin-Shealy Co., 1945).

[21] We conjecture the excess is positive. See footnote 19.

TABLE 4. MALE OPERATIVES IN ALL MANUFACTURING AND IN FOOD AND KINDRED, BY CITY GROUPINGS, 1950

	In standard metropolitan areas[1]		Outside of standard metropolitan areas[2]	U. S. total[3]
	With more with 25,000 operatives in manufacturing[4]	With less than 25,000 operatives in manufacturing		
All manufacturing	1,210,250	544,640	1,435,627	3,190,517
Food and kindred	102,860	59,025	141,584	303,469
Food and kindred as a per cent all manufacturing	8.50	10.84	9.86	9.51

[1] Source: U. S. Bureau of the Census: *U. S. Census of Population: 1950*, P-C Series (Washington: Government Printing Office, 1953), Table 78.
[2] Obtained by subtracting metropolitan areas from total.
[3] Source: U. S. Bureau of the Census: *U. S. Census of Population: 1950*, P-C Series (Washington: Government Printing Office, 1953), Table 125.
[4] These comprise 15 of the 76 areas, as follows: Providence, Boston, Buffalo, New York, Northeastern New Jersey, Philadelphia, Pittsburgh, Baltimore, Cincinnati, Cleveland, Detroit, Chicago, Milwaukee, St. Louis, Los Angeles, San Francisco, Oakland.

optimal distribution of labor between food and the rest of the economy. The relative concentration in the West—a high wage area—may indicate some tendency toward a less than optimal amount of labor in food.[22]

Table 4 throws light on the concentration of employment by community-size. One might suppose that such concentrations make for too much emplyment in food processing, since wages in small communities tend to be low and since one sometimes thinks of concentrations of food processing in small communities. This is not suggested by Table 4, however, since the concentrations of employment for manufacturing and for food are quite similar in the larger standard metropolitan areas, in the smaller standard metropolitan areas, and in the still smaller communities not included in the standard metropolitan areas.[23]

The data from the 1947 *Census of Manufacturers* pertaining to the distribution of establishments by counties and industry groups also throw light on community-size concentration. As discussed below in another connection, these may indicate some minor tendency towards concentration in very small communities.[24]

[22] This conclusion is unusual in that we are saying that a concentration due principally to canning may be a concentration where wages are too high. One often thinks of canning employees as being low paid. However, the earnings data in this study as presented in Table 2 indicate that in the Pacific Region canning employees are not particularly low paid. The .107 residual for the Pacific comes close to offsetting the —.48 industrial differential. Because of the large residual the text conclusion holds a fortiori.

[23] Perhaps, however, there is some concentration concealed among the smaller communities. This is suggested if the difference in analysis of variance as between states and metropolitan areas (see footnote 5) is due to community-size concentration.

[24] See page 710.

Race, sex and plant size. Mention was made above that it would be useful to know whether locational differences in wages are excessive.[25] The same statement can be made regarding wage differences associated with other characteristics. Without being very sure, let us conjecture that there may be excessive differences between earnings of Whites and Nonwhites; males and females; and workers in large plants as opposed to small plants.[26]

The distributions by race of employees in manufacturing, in bakery products, and in other food, are virtually identical. Only in meat products is there a marked difference. (See Table 5.) The proportion of males in all food and kindred is quite close to the proportion in all manufacturing, but there is considerable variation within food and kindred. The greatest relative cncentration of females occurs in the confectionery group. (See Table 6.) For total manufacturing, 75 per cent of employees are in plants employing a hundred or more, whereas in food and kindred only about 60 per cent of employees are in such plants. Dispersion within food and kindred group is revealed by the fact that meat packing is higher than even the manufacturing average. (See Table 7.)

The total wage bill is apparently little affected by differentials associated with these concentrations. One can easily verify that excessive wage differentials substantially greater than observed differentials would be required if there were to be much effect.[27] Hence we conclude that race, sex and plant-size probably are not important influences on total employment in food processing.

Do the labor markets appear competitive? Boulding says, "A competitive market may be defined as a large number of buyers and sellers, all engaged in the purchase and sale of identically similar commodities, who are in close contact with one another and who buy and sell freely among themselves."[28]

Whether there is "a large number of buyers" is particularly important in the present study. Equality of remuneration in given labor market areas does not necessarily preclude situations where there is only one or a small number of firms taking account of the effects of their own action on the supply of labor. In these situations, even though comparable labor received equal remuneration, we might have reason to believe that remuneration does not coincide with marginal product. What we wish to do is test for the existence of monopsony or oligopsony in labor markets. A

[25] See page 706.

[26] These wage differences have been noted by writers referred to earlier, footnote 20. But evidence seems inconclusive on whether the differences are excessive. As with location, we have in mind positive excessive differences.

[27] On the significance of measures of the wage bill, see footnotes 7 and 8.

[28] Kenneth Boulding, *Economic Analysis* (New York: Harper and Bros., 1941), page 50.

TABLE 5. PER CENT DISTRIBUTION BY RACE OF EMPLOYED PERSONS IN SELECTED INDUSTRY GROUPS, BY SEX, 1950

Industry group and sex	Race		
	White	Negro	Other
Males			
All manufacturing	92.3	7.5	0.2
Meat products	84.8	15.1	0.1
Bakery products	93.5	6.4	0.1
Other food industries	92.5	7.2	0.3
Females			
All manufacturing	95.0	4.8	0.3
Meat products	88.6	11.2	0.1
Bakery products	94.2	5.7	0.1
Other food industries	92.6	7.0	0.5

Source: U. S. Bureau of the Census, *U. S. Census of Population: 1950*, Vol. II, Part 1 (Washington: Government Printing Office, 1953), Table 133.

TABLE 6. PER CENT FEMALE OF EMPLOYED PERSONS IN SELECTED INDUSTRY GROUPS, 1950

All manufacturing	25.0
Food and kindred products	22.7
Meat products	20.4
Dairy products	16.3
Canning and preserving	39.8
Grain-mill products	12.7
Bakery products	22.9
Confectionery	49.9
Beverage	11.8

Source: U. S. Bureau of the Census, *U.S. Census of Population: 1950*, Vol. II, Part I (Washington: Government Printing Office, 1953), Table 130.

TABLE 7. EMPLOYMENT BY SIZE OF ESTABLISHMENT IN SELECTED INDUSTRY GROUPS, 1947

Industry group	Establishments employing		Total
	Less than 100	100 or more	
Number of employees:			
Manufacturing	3,578,448	10,715,856	14,294,304
Food and kindred	598,167	843,680	1,441,847
Meat packing, wholesale	34,136	174,233	208,369
Canning and preserving (except fish)	50,508	85,466	135,974
Percentages:			
Manufacturing	25.03	74.97	100.00
Food and kindred	41.49	58.51	100.00
Meat packing, wholesale	16.38	83.62	100.00
Canning and preserving (except fish)	37.14	62.82	100.00

Source: U. S. Bureau of the Census, *Biennial Census of Manufactures: 1947*, Vol. I (Washington: Government Printing Office, 1950), chap. iii, Table 1.

test is provided by assuming that the likelihood of this type of situation varies inversely with the number of firms hiring labor in a labor market area.

Let us refer again to data from the 1947 *Census of Manufactures* pertaining to the distribution of establishments according to employment size and major industry.[29] There were 114 counties containing only establishments in the food and kindred group, out of a total of 1,712 counties with manufacturing establishments having 100 or more employees in 1947.[30] These 114 counties accounted for 165 establishments out of a total of 2,838 food and kindred establishments and 24,542 manufacturing establishments in the country. In approximately 176 counties the proportion of food and kindred establishments is one-half or more.[31] In approximately 235 counties the proportion is one-third or more, and in approximately 263 the proportion is one-fourth or more. Since the total number of counties with manufacturing establishments is 1,712 more than five-sixths of the counties seem with practical certainty to contain no monopsony.[32]

Thus, although data from the 1947 *Census of Manufactures* seem to indicate a slight relative tendency for food processing to be located in the less urban centers, the tendency is not a strong one. The great majority of employment in food processing takes place in locales where workers have many alternative employment opportunities.[33]

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[29] These data were referred to earlier in considering the location of food processing. See page 707.

[30] The data in this paragraph were obtained from U. S. Bureau of the Census, *Biennial Census of Manufactures: 1947*, Vol. 1 (Washington: Government Printing Office, 1950), Chap. III, Table 1, page 97, and U. S. Bureau of the Census, *Biennial Census of Manufactures: 1947*, Vol. III (Washington: Government Printing Office, 1950), Table 8.

[31] Only an approximation is available because of grouping of some counties for ease of examination into class intervals with respect to number of establishments. All counties were assumed to be at the midpoint of the class interval.

[32] Two shortcomings of the above analysis may be noted. The first is that the data refer to number of establishments rather than number of employees. Thus in some cases one single establishment, because of its size may dominate the labor market even though there are many establishments in the area. There seems no way of allowing for this possible error. The second shortcoming is that only establishments with 100 or more employees have been considered. These establishments employed 10,715,856 out of 14,294,304 employees in all manufacturing and 843,680 out of 1,441,847 employees in the food and kindred group. These data, then, apply to the majority of employees in the food and kindred group, but it cannot be denied that a substantial part of the labor force has been excluded.

[33] Whether there are a large number of sellers of labor is not so important to the present study as the question just considered of whether there are a large number of buyers. If unions have forced up wages, similarity of earnings suggests they might have done so about equally in food and in manufacturing—with no particular relative effect on the amount of labor firms hire in food. Justifiably, then, the present study has not dealt with the effect of unions on wages.

Two possibilities, however, lend particular importance to examining the number of buyers of labor: (1) If a dominant firm in an area takes account of the effect of its

To continue with Boulding's definition, let us consider evidence relevant to whether those in the labor markets "buy and sell freely among themselves." Seasonal and yearly variability in supplies of raw materials used in food processing is associated with variations in the demand for labor and thus with variaiblity in employment. High labor turnover indicates that employers bid often for labor, so that both parties to the wage bargain are constantly being made aware of alternative opportunities.[34] Table

TABLE 8. MONTHLY LABOR TURNOVER RATES IN SELECTED INDUSTRY GROUPS

Industry Group	1950	1951	1952	1953	1954	1955
Total Accession Rate						
All manufacturing	4.4	4.4	4.4	3.9	3.0	3.7
Food and kindred	4.7	5.7	5.3	5.2	4.0	4.2
Meat products	5.8	6.9	5.4	5.1	4.8	4.5
Grain-mill products	3.0	4.9	4.6	4.0	2.9	3.2
Bakery products	3.7	4.9	4.7	4.8	3.1	3.4
Malt liquors	4.2	4.6	4.4	5.1	3.5	4.2
Total Separation Rate						
All manufacturing	3.5	4.4	4.1	4.3	3.5	3.3
Food and kindred	4.8	5.6	5.3	5.5	4.3	4.2
Meat products	5.7	6.7	5.6	5.3	4.9	4.6
Grain-mill products	3.1	4.4	4.5	4.6	3.0	3.2
Baking products	3.8	4.9	4.5	4.9	3.3	3.3
Malt liquors	4.4	4.4	4.2	5.6	3.6	4.2

Source: U. S. Bureau of Labor Statistics, *Employment and Earnings*, Vol. 2, No. 12 (June 1956), p. 94.

8 shows that accession and separation rates are consistently somewhat higher in the food and kindred group than in total manufacturing. Meat packing reveals the highest labor turnover; but grain and bakery are not generally above total manufacturing.[35]

Another part of Boulding's definition refers to the extent to which buyers and sellers are "engaged in the purchase and sale of identically similar commodities." Table 9 throws light on this. Those tasks in each industry

own action on wages, the marginal product of labor for that firm may be higher than the wage whereas for non-dominant firms the wage may equal marginal product. (2) Monopsony and oligopsony may be a source of excessive locational wage difference, so that the present evidence bears to some extent on the earlier discussion of location.

[34] Social security statistics are another source of information on labor turnover, although data are presented only for food and kindred as a whole. These data are corroborative of Table 8. They reveal that food and kindred, in comparison to all manufacturing, is characterized by a high proportion of multi-industry workers. U. S. Bureau of Old-Age and Survivors Insurance, *Handbook of Old Age and Survivors Insurance Statistics 1950* (Washington: Government Printing Office, 1953), page 104.

[35] Labor must of course have alternative employment opportunities and not simply remain unemployed in off-seasons.

performed by common or semi-skilled labor, requiring no special aptitudes, education or experience, can reasonably be considered as alternatives for a large segment of the labor force. High skill and specialization are unlikely in four occupational classifications, namely, clerical, sales, operatives and laborers. The remaining classifications in Table 9 probably

TABLE 9. PER CENT DISTRIBUTION BY MAJOR OCCUPATION GROUP OF EMPLOYED MALES IN SELECTED INDUSTRY GROUPS, 1950

Occupation Group	Industry Group			
	All Manufacturing	Meat Products	Bakery Products	Other Food Industries
Professional, technical and kindred	5.7	2.3	1.0	3.6
Managers, officials and proprietors	6.0	7.2	7.4	10.9
Clerical and kindred	6.6	7.7	5.3	6.3
Sales	3.6	6.2	6.5	6.3
Craftsmen, foremen and kindred	24.8	9.6	36.7	15.5
Operatives and kindred	39.5	49.2	36.1	40.0
Service	2.2	2.9	3.2	2.6
Laborers	11.1	14.3	3.7	14.3
Occupation not reported	0.4	0.4	0.2	0.4
Total	99.9	99.8	100.1	99.9

Source: U. S. Bureau of the Census, *U. S. Census of Population: 1950*, Vol. II, Part 1 (Washington: Government Printing Office, 1953), Table 134.

include many such workers also. In every case, the four groups that definitely consist of unskilled and semi-skilled labor account for a majority of workers, and in all except bakeries, the majority is very substantial.

Conclusions. Major conclusions based on the structural data are as follows:

(1) Despite a great deal of similarity in locational concentration of food processing and all manufacturing, the data do not rule out the possibility that there is some tendency for food processing to occur with above average frequency in low-wage areas.
(2) Race, sex and plant-size appear unimportant as influences on aggregate employment in food processing.
(3) Aside from the locational tendency already noted, the labor markets seem generally to be competitive, since (a) there are almost always alternative employment opportunities available, (b) higher-than-average labor turnover suggests movement among alternatives, and (c) food processing utilizes labor of skill similar to that in the rest of manufacturing.

Taken together with the earnings comparisons in the first part of this paper, the above conclusions would seem to indicate that there must be a substantial degree of efficiency in the labor market for food processing. By this we mean that the preponderant number of workers in food processing must tend to receive the same wage as they could obtain in employment in the rest of the economy. The indication is that such labor

market inefficiencies as may exist usually impinge equally in food and in manufacturing. Indeed, one of our most important results may be the finding of so much similarity between employment in food and in all manufacturing.

The only objective measures we have to indicate a precise degree of efficiency are the T and I coefficients presented in Figure 1. These coefficients do not indicate the possibility of an impressive gain in product from redistributing labor between food and manufacturing. According to the coefficients, food processing compares favorably with other manufacturing industries. A possibly important qualification regarding the T and I coefficients, however, is that they are based on earnings comparisons restricted to standard metropolitan areas. These data, along with other available data, suggest few labor market inefficiencies inimical to food processing. Although more information if available might give similar indications, we do not rule out the alternative possibility that other data might not indicate such a high degree of efficiency.

A SIMPLIFIED FEED-MIX MODEL*

R. F. HUTTON AND R. H. MCALEXANDER
Pennsylvania State University

A PROGRAMMING model for meeting the logical problems in formulating feed mixes under mill-operating conditions was presented by Hutton and Allison in an earlier paper.[1] An attempt was made in this earlier paper to consider many of the problems confronted in formulating least-cost feed mixes. More recent efforts have been directed toward simplifying the feed-mix model. Progress has been made to the extent that solutions using desk calculators appear feasible with the use of revised models and supplementary computing techniques.

The computing techniques that have been found useful in connection with this problem are believed to have wide application in other programming problems. In this exposition, however, attention will be centered upon the feed-mix problem.

The Problem

Feed mixers are faced with the problem of adjusting their feed formulas to changes in ingredient prices and ingredient supplies. This adjustment is restricted to something less than the least-cost optimum for any given set of nutritional specifications of a mix by such factors as purchaser preference, mix appearance and mix palatibility.[2] A feed-mix model that directly considers all of these restrictions is not beyond the bounds of feasibility but it is cumbersome. Solution of such a model requires access to electronic computers if the solutions are to be of maximum usefulness. Few mills have ready access to such equipment at the local milling points where the decisions need to be made. Thus there is need for a model that will permit solutions with desk calculators.

The General Procedure

A feed mix often cannot be formulated entirely from feeds that can be used in unlimited quantities. In order to meet all the specifications of a particular feed mix it is generally necessary to use some ingredients that are either in limited supply or for other reasons have restricted use.[3] If

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[1] "A Linear Programming Model for Feed Formula Development Under Mill-Operating Conditions," *Journal of Farm Economics*, Vol. 40 No. 1, February, 1957.

[2] There are other non-nutritional specifications such as bulk and use of "in-transit" material that may be handled in the same manner as the nutritional specificiations. The above cited paper presents details on these aspects of the problem. At any point in time the commercial mixer may be limited to use of only those ingredients registered for the feed being mixed.

[3] See R. F. Hutton, and J. Allison, *op. cit.* for discussion of reasons for restrictions upon ingredient use.

these ingredients with restricted use are included in the feed mix at levels known to be safe, both from the standpoint of feed quality and supply, the residual requirements of the mix can generally be satisfied by ingredients not having supply or quality restrictions.

The procedure presented in this paper for determining a feed mix consists of three basic parts. First, a portion of the mix is arbitrarily developed from the restricted ingredients. This portion must be selected so that residual part of the mix can be formulated from unrestricted ingredients, and also the level of use of individual ingredients must be consistent with supply and quality restrictions of that ingredient. Secondly, the residual portion of the mix is formulated from ingredients freely available and of acceptable quality. Finally, the ingredients in the solution of the residual portion of the mix are displaced by less costly restricted ingredients up to the limit of use of the ingredient. This displacement is controlled so that the mix specifications are met throughout.

The procedure uses the coefficients of a linear programming solution of the residual portion of the mix in the process of displacement of ingredients. All ingredients that can be used in the mix are included in the model. Those that are restricted in their use are blocked from entry by being assigned artificially high prices. The unrestricted ingredients are thus forced to form a solution. The coefficients of the vectors of blocked ingredients in this solution define the displacement rates used in modifying the mix.

The details of this procedure are presented in connection with the discussion of the accompanying illustrative problem.

An Illustrative Problem

A 16-percent-protein mixed dairy feed is used as an illustration for explaining the procedure. Specifications for this feed mix are shown in Table I. These specifications are set by the mill for a particular time period. Certain of the specifications, particularly upper limits on the ingredients, are subject to frequent change.

The portion of the mix described in Table II was developed from the restricted ingredients listed in Table I. For the sake of reference this portion of the mix will be referred to as the "premix." Actually some ingredients in this group would and others would not be premixed in the milling of the feed.

In developing the premix of Table II, no great precision was sought in getting minimum levels of the restricted ingredients. Experience has shown that the ingredients included in the premix generally enter the least-cost mix at levels higher than those indicated in Table II.[4] However,

[4] Molasses was included at less than the minimum quantity shown as being required in Table I. This was because there was interest in determining the effect of reduction of the level of molasses on the cost of the feed mix. Ordinarily, one would include at least the minimum requirement of the ingredient in the premix.

TABLE I. SPECIFICATIONS FOR A 16-PERCENT-PROTEIN MIXED DAIRY FEED

Item	Specification
Feed characteristics:	
Weight	1 ton
Protein	15.7%*
Fat	4% or more
T.D.N.	1,400 pounds or more
Fiber	10% or less
Bulk	3.45 ± .255 bushels per hundred weight
Restricted ingredients:	
Salt	20# per ton
Dicalcium phosphate	20# per ton
Wheat bran	300# per ton or less
Wheat standard middlings	300# per ton or less
Wheat bran and wheat standard middlings	500# per ton or less
Oats	100# per ton or more
Corn gluten feed	440# per ton or less
Corn distiller's dried grains	60# to 180# per ton
Rice bran	200# per ton or less
Molasses	220# per ton

* The ingredients used in formulating the mix exceed the table values used for protein; thus a 16% mix can be developed if the protein specification is set at a nominal 15.7%.

even if the level of these ingredients were set higher than they would occur in the final solution, they could be adjusted downward in later computation.

The ingredients assumed to be unrestricted in the development of the solution to the residual portion of the mix are: corn, oats, barley, soybean-oil meal and a fixed-proportion mixture of hominy and cornmeal.

Table III describes all of the processes for solving the residual portion

TABLE II. QUANTITIES OF RESTRICTED INGREDIENTS ADDED ARBITRARILY AS A PREMIX TO A 16-PERCENT-PROTEIN DAIRY MIX

Item	Specification
Premix characteristics:	
Weight	.4 ton
Protein	115.2#
Fat	40.2#
T.D.N.	649.84#
Fiber	71.0#
Bulk	1.44 bu. (or 41.8% of bulk permitted)
Restricted ingredients:	
Salt	20# per ton
Dicalcium phosphate	20# per ton
Wheat bran	200# per ton
Wheat standard middlings	200# per ton
Oats	100# per ton
Corn distiller's dried grains	60# per ton
Rice bran	100# per ton
Molasses	100# per ton

TABLE III. PROCESSES FOR THE ILLUSTRATIVE FEED-MIX PROBLEMS

	P_0	Wt. disposal	Prot. disposal	Fat disposal	TDN disposal	Fiber disposal	Bulk disposal	Variation disposal	Bulk increase	Bulk decrease	Soybean oil meal	Corn
Weight (T)	1.0	1.0									1	1
Protein			1.0								— 44%	— 8.6%
Fat				1.0							— 0.5%	— 3.9%
T.D.N. (#/T)					1.0						−1,570	−1,602
Fiber						1.0					6.0%	2.0%
Bulk (bu/cwt.)							1.0		.255,010	−.255,010	2.22	2.17
Bulk variation								1.0	1.0	1.0		

	Barley	Oats	Wheat standard middlings	Corn gluten feed	Wheat bran	Hominy and corn meal	Corn distillers' dried grains	Rice bran	Molasses	Mix
Weight (T)	1	1	1	1	1	1	1	1	1	.4
Protein	— 11.5%	— 12.0%	— 17.0%	— 21.0%	— 16.0%	— 9.8%	— 26.0%	— 12.0%	— 3.0%	9.94%
Fat	— 2.0%	— 4.0%	4.0%	2.0%	— 4.0%	— 5.4%	— 7.0%	— 12.0%		1.99
T.D.N. (#/T)	−1,554	−1,402	−1,550	−1,526	−1,364	−1,646	−1,618	−1,340	−1,080	750.16
Fiber	7.0%	12.0%	8.0%	8.0%	11.0%	4.0%	15.0%	12.0%		−6.45
Bulk (bu. cwt.)	2.44	3.64	3.70	2.70	6.25	2.50	2.65	3.28		−2.01
Bulk variation										−1

of the mix.[5] The mix process expresses the residual requirements above the amounts satisfied by the premix given in Table II. The "bulk increase" and "bulk decrease" processes permit the variation in bulk allowed in the specifications for this mix.

The problem was run with "c_j" values indicated in Table IV. However, the coefficients obtained, other than the "$z_j - c_j$", are of general usefulness for any set of "c_j" values, as will be explained later.

The ingredients that may enter at unlimited levels are given a "c" value equal to their cost per ton multiplied by -1. The ingredients that may

TABLE IV. "c_j" VALUES FOR PROCESSES HAVING NON-ZERO "c_j" IN THE INITIAL SOLUTION OF THE ILLUSTRATIVE FEED-MIX PROBLEM

Process	"c_j" value	Process	"c_j" value
Weight disposal	−1,000.00	Hominy-cornmeal	− 53.9000
Protein disposal	−1,000.00	Middlings	−1,044.29
Bulk disposal	−1,000.00	Corn gluten feed	−1,050.72
Soybean oil meal	− 57.65	Wheat bran	−1,048.03
Corn	− 54.45	Corn distiller's dried grains	−1,058.62
Barley	− 50.80	Rice bran	−1,046.27
Oats	− 58.70	Molasses	−1,052.56
		Mix (cost of premix)	− 19.45

not enter at unlimited levels are given a "c" value of equal to $1,000 plus their cost per ton multiplied by -1. The addition of $1,000 per ton to the price was sufficient to prevent any of these ingredients from being included in the solution. The disposal processes for weight, protein, and bulk were prevented from being included in the solution by being assigned "c_j" values of $-1{,}000$. The mix process as given a "c" value equal to the cost of the material in the premix. This was done so that the "z_o" value in the solution tableau would include the cost of the premix.

The initial solution obtained for this problem is given in the P_o vector of Table V. The cost of the mix at this stage of computation is $52.97 per ton.

A considerable part of the solution tableau is of no further value in making the desired modifications. In practice, the problem indicated in Table III is coded for computer solution and the solution is decoded for use. The full solution tableau is not presented in Table V because an

[5] The "Simplex" solution procedure was used in this problem. For a discussion of this procedure see Charnes, Cooper and Henderson, *An Introduction to Linear Programming*, New York: Wiley, 1953, p. 10, or E. O. Heady, "Simplified Presentation and Logical Aspects of Linear Programming Techniques," *Journal of Farm Economics*, Vol. 36, December 1954, p. 1,043.

TABLE V. DECODED COEFFICIENTS OF THE SOLUTION TABLEAU THAT ARE OF RELEVANCE TO FURTHER CALCULATIONS

Row vector in solution tableau	P_0	Selected column vectors of solution tableau*										
		Weight disposal (T)	Protein disposal (30#)	Fat disposal (1#)	Bulk disposal (bu/T)	Corn (T)	Wheat standard middlings	Corn gluten feed (T)	Wheat bran (T)	Corn distiller's dried grains (T)	Rice bran (T)	Molasses (T)
Soybean oil meal (#)	192.6	− 587.6	−62.5	− 1.63	− 4.0	− 97.4	−307.7	572.8	39.8	1,054.4	290.6	− 400.2
Barley (#)	250.8	5,763.8	94.4	31.26	−29.3	1,244.0	−506.8	951.4	−1,905.6	−2,604.9	−4,790.2	5,480.9
Oats (#)	503.7	−4,926.9	−10.4	1.24	85.2	− 537.4	2,154.0	541.7	6,488.5	850.0	1,187.7	−4,195.8
Hominy-cornmeal (#)	253.4	1,050.7	−21.5	−30.86	−51.9	1,390.8	45.1	−65.9	−2,622.7	3,200.5	5,311.9	1,115.1
Fiber disposal (#)	29.3	97.0	− .75	− 1.00	− 5.9	32.4	− 53.3	− 3.3	− 322.7	249.1	202.9	99.3
TDN disposal (#)	157.2	1,918.9	.70	− 1.53	− 8.9	56.0	−155.2	−11.6	− 423.5	65.1	370.4	841.0
$z_j - c_j$**	−52.97	− 33.72	5.76	.98	− 4.85	3.95	16.14	− 4.08	− 29.47	− 2.13	− 18.45	17.98

* Unit level of some processes have been changed thus these vectors are not directly comparable with the vector presented in Table III. Unit levels are given below each process name.

** This includes the cost of the premix which is $19.45.

understanding of it would involve a discussion of the mechanics of coding and decoding. Irrelevant row and column vectors have been omitted. The discussion of the standard bran vector which follows includes a complete listing of the seven row vectors in the solution tableau. The "bulk increase" and the "mix" vectors give no information useful in the determination of the least-cost mix. Thus they were omitted from the decoded tableau.

Certain of the column vectors of the solutions tableau described in Table III are of no further value. The vectors for "bulk variation disposal," "bulk increase" and "bulk decrease" give no information that cannot be readily obtained from the "bulk disposal" vector. Thus, these three can be safely dropped from the decoded tableau. "Weight disposal" is retained because it has a usefulness to be explained later. The "mix" vector can also be dropped since it is in the solution and there is no logical possibility of its leaving the solution. The relevant portion of the scaled-down decoded solution tableau is presented in Table V.

The next step in the procedure is to attempt to adjust this solution, with regard to the mix specifications, to reduce the cost. The "$z_j - c_j$" values for the blocked ingredients in the above solution are examined to determine whether the true value of any is negative. If any "$z_j - c_j$" values are negative, the cost of the mix may be reduced by adding those ingredients. As an ingredient is added, other ingredients already in the solution must be displaced. The cofficients of the ingredient vector in the solution tableau will indicate the changes that need to be made as this new ingredient is added. For example, the vector for one ton of wheat bran in the initial solution tableau was as follows:

Row vector identification	Wheat bran column vector values (1 ton)
Soybean oil meal	39.8
Barley	−1,905.6
Oats	6,488.5
Hominy cornmeal	−2,622.7
Fiber disposal	− 322.7
T.D.N. disposal	− 423.5

The coefficients in the above wheat bran vector indicate the adjustments that would be required if this ingredient were to be brought in at unit level (i.e. at one ton). It is impossible to bring this or any other ingredient in at unit level since, for one thing, all ingredients combined must weigh only 1,200 pounds. The premix weights 800 pounds. These magnitudes, therefore, must be viewed as rates of displacement that hold for some range of use. This wheat bran vector indicates that if wheat bran

were added, displacement at the following rate per unit of wheat bran is possible for some range without violating the specifications of the mix:

1. Soybean-oil meal would be decreased by 39.8 pounds.
2. Barley would be increased by 1,905.6 pounds.
3. Oats would be decreased by 6,488.5 pounds.
4. Hominy cornmeal would be increased by 2,622.7 pounds.
5. Fiber would be reduced 322.7 pounds per ton of mix.
6. T.D.N. would be increased 423.5 pounds per ton of mix.

Perhaps a few words of explanation concerning the signs of the coefficients in the colum vectors would be helpful. If an ingredient is to be added to the mix, it's vector values must be subtracted from the corresponding P_o vector values. A *positive* coefficient, therefore, indicates that the ingredient or process represented by the row upon which the coefficient appears must be *reduced;* a *negative* coefficient indicates that the process of that row must be *increased.*

The next important step is to establish the limit for the substitution of the type described in connection with the discussion of wheat bran above. In general, it may be carried until either:

1. A process (or ingredient) in the existing solution is forced to zero level; or,
2. The level of entry of the process reaches the level set by the mix specifications.

In the case of wheat bran, the specifications of Table I limit it to 300 pounds per ton. But, 200 pounds of wheat bran was added in the premix described in Table II. Thus, only 100 pounds or 5 percent of a ton of wheat bran can be added before the limit set by mix specifications is reached. The question then arises, can 5 percent of wheat bran be added without forcing a process (or ingredient) to enter at a negative level? In this instance, the answer is "yes." This can be proved by subtracting 5 percent of each of the coefficients in the wheat bran vector given above from the corresponding coefficient in the P_o vector of the solution.

The data necessary for this calculation are presented in Table VI. The coefficients in this table are taken from the vectors of the solution tableau presented in Table V.

The modified solution given in Table VI now includes 190.6 pounds of soybean-oil meal, 345.6 pounds of barley, 179.3 pounds of oats, 384.5 pounds of hominy cornmeal and 100 pounds of wheat bran plus the premix shown in Table II. Cost of a ton of the mix has been decreased from \$52.97 to \$51.50, or by 5 percent of the "$z - c$" value for wheat bran.

One of the specifications shown in Table I is an exact requirement of 11-percent molasses. Since the premix described in Table II included only 5-percent molasses, an additional 6 percent of a unit of molasses must be

TABLE VI. CHANGE IN MIX RESULTING FROM ADDITION OF 100 POUNDS OF WHEAT BRAN

Ingredient	Amount in initial solution (pounds)	Change indicated by entry of unit (T) of wheat bran (pounds)	Change Indicated by entry of 5% of unit of wheat bran (pounds)	Amount in modified solution (pounds)
Soybean oil meal	192.6	subtract 39.8	subtract 2.0	190.6
Barley	250.3	add 1,905.6	add 95.3	345.6
Oats	503.6*	subtract 6,488.5	subtract 324.4	179.3
Hominy cornmeal	253.4	add 2,622.7	add 131.1	384.5
Wheat bran	0	add 2,000.0	add 100.0#	100.0

* Total mix includes 100 pounds added in the premix.

added. When this is done, as in the manner outlined above for wheat bran, barley is forced to a negative level. (See Table VII for details of forcing 6 percent of a unit of molasses into the initial solution mix). Logically, a negative quantity in the P_o column is not permitted in a final solution. The condition of having a negative barley level may be temporarily violated in the development of the mix without harmful effect to the final solution. Other adjustments can be made that will have the effect of increasing the barley coefficient.

Table V gives the decoded "$z_j - c_j$" values for the ingredients that were blocked by large negative "c" values in the initial solution. Molasses was the only ingredient having a positive "$z_j - c_j$" value. This indicates that the cost of the mix will be increased by meeting the 11-percent molasses requirement.

Instead of forcing in molasses as is illustrated in Table VII, the most direct approach to the solution at this point is to force into the solution as a group the 6-percent molasses plus all processes having negative "$z_j - c_j$" values. The ingredients could be brought into the solution at the limit permitted by the specifications of the mix. We need to take into account that molasses must be forced into the solution even though its "z − c" value is positive, and that part of the amount of each ingredient

TABLE VII. MODIFICATION OF INITIAL SOLUTION BY THE ADDITION OF 6-PERCENT MOLASSES

Ingredient	Amount in initial solution (pounds)	Change indicated by entry of unit (T) of molasses (pounds)	Change indicated by entry of 6% of unit of molasses (pounds)	Amount in modified solution (pounds)
Soybean oil meal	192.6	add 400.2	add 24.0	216.6
Barley	250.3	subtract 5,480.9	subtract 328.8	−78.5
Oats	603.7*	add 4,195.8	add 251.7	755.4
Hominy cornmeal	253.4	subtract 1,115.1	subtract 66.9	186.5
Molasses	100.0	add 2,000.0	add 120.0	220.0

* Includes 100 pounds added in the mix.

permitted in the specifications has already been used in the premix.

To summarize the current position, we must add 6 percent of a ton of molasses; and we may add in a final solution the following amount of the ingredients initially blocked, if they do not violate the rule that an ingredient cannot remain at a negative level.

Ingredient	Amount permitted or required by mix specifications and not included in premix (pounds)
Wheat bran or wheat standard middlings	Up to 100#
Corn gluten feed	Up to 440#
Corn distiller's dried grains	Up to 120#
Rice bran	Up to 100#
Molasses	Exactly 120#

A choice must be made between wheat bran and wheat standard middlings as a user of the joint capacity of 100 pounds. A tentative choice can be made on the basis of the size of the "z − c" value (see Table V), thus, wheat bran is chosen for entry, at least for the moment.

An attempt can now be made to modify the mix by adding all the ingredients blocked in the initial solution at the limits specified above. To do this, it is necessary to compute 5 percent of the value of the coefficients in the wheat bran vector, 22 percent of the corn-gluten feed vector, 6 percent of the corn distiller's dried grains vector, 5 percent of the rice bran vector and 6 percent of the molasses vector. These scaled-down coefficients are then added across columns. These sums will give a correction vector that can be subtracted element from element from the P_0 vector. If none of the differences obtained in this substraction are negative, the least-cost solution is obtained. This step in the procedure is presented in Table VIII.

The result of this modification is not acceptable solution in this problem since hominy cornmeal entered at a negative level. Some further adjustment is obviously needed. The optimum adjustment involves finding the least expensive manner in which hominy-cornmeal may be brought from the present value of −125.5 up to a zero level.

This correction can be accomplished in two different ways. First, ingredients can be added whose increase results in the addition of hominy cornmeal; or, secondly, ingredients can be removed from the mix whose reduction results in an addition of hominy cornmeal. This addition or removal of ingredients also would have to be in accordance with the mix specifications set forth in Table II.

The ingredients that fall into these categories can be identified by inspecting their coefficients in the hominy-cornmeal row. Those ingredients

TABLE VIII. DEVELOPING A CORRECTION VECTOR FOR MODIFYING THE INITIAL SOLUTION TO THE ILLUSTRATIVE DAIRY MIX PROBLEMS

Row vector identification	P_0	Wheat bran	Corn gluten feed	Corn distiller's dried grains	Rice bran	Molasses	Correction vector	Modified P_0
				Value in initial solution				
Soybean oil meal	+192.6	+ 39.8	+572.8	+1,054.4	+ 290.6	− 400.2		
Barley	+250.3	−1,905.6	+951.4	−2,604.9	−4,790.2	+5,480.9		
Oats	+503.7	+6,488.5	+541.7	+ 350.0	+1,187.7	−4,195.8		
Hominy cornmeal	+253.4	−2,622.7	− 65.9	+3,200.5	+5,311.9	+1,115.1		
Fiber disposal	+ 29.3	− 322.7	− 3.3	+ 249.1	+ 202.9	+ 99.2		
TDN disposal	+157.2	− 423.5	− 11.6	+ 65.1	+ 370.4	+ 841.0		
$z_j - c_j$	− 52.97	− 29.47	− 4.08	− 2.13	− 18.45	+ 17.98		
				Scaled values*				
Soybean oil meal	+192.6	+ 2.0	+126.0	+ 63.3	+ 14.5	− 24.0	+181.8	+ 10.8
Barley	+250.3	− 95.3	+209.3	−156.3	−239.5	+328.8	+ 47.0	+203.3
Oats	+503.7	+324.4	+119.2	+ 21.0	+ 59.4	−251.7	+272.3	+231.4
Hominy cornmeal	+253.4	−131.1	− 14.5	+192.0	+265.6	+ 66.9	+378.9	−125.5
Fiber disposal	+ 29.3	− 16.1	− .7	+ 14.9	+ 10.1	+ 6.0	+ 14.2	+ 15.1
TDN disposal	+157.2	− 21.2	− 2.6	+ 3.9	+ 18.5	+ 50.5	+ 49.1	+108.1
$z_j - c_j$	− 52.97**	− 1.47	− .90	− .13	− .92	+ 1.08	− 2.34	− 50.63**

* The vectors were scaled to the following percentages: wheat bran 5%, corn gluten feed 22%, corn distiller's dried grains 6%, rice bran 5%, molasses 6%.

** This includes the cost of the premix of $19.45.

having *negative* coefficients will result in an increase in the hominy-cornmeal coefficient if they are *increased*. Those ingredients having a *positive* coefficient will provide an increase in the hominy-cornmeal coefficient if they are *reduced*.

Of the ingredients given in Table VIII, corn-distiller's dried grains, rice bran and molasses have positive coefficients in the hominy-cornmeal row. Thus, reduction in any one of these ingredients would require an increase in the hominy-cornmeal coefficient in the P_o column. Wheat bran and corn gluten have negative coefficients in the hominy-cornmeal row. Thus, the hominy-cornmeal coefficient would be increased if either of these ingredients were increased. However, both wheat bran and corn gluten feed are at the maximum permitted by the mix specifications. This means that the upward adjustment in hominy-cornmeal level must come from a reduction in the level of molasses, rice bran, or corn distiller's dried grains.[6]

Molasses is required at an exact level, so it cannot be reduced. This narrows the list of possible ingredients to rice bran and corn distiller's dried grains. The ingredient selected will be the one providing the least increase in the cost of the mix. A comparison of the "$z - c$" values alone is not a reliable basis of choice in this instance. The reduction of these two ingredients increase hominy-cornmeal in proportion to the size of the coefficient in the hominy-cornmeal row. Therefore, the ratio of "$z - c$" to the coefficient of the hominy-cornmeal row may be used as the basis of choice between the ingredients. Withdrawal of rice bran will increase the cost of the mix \$18.45 ÷ 5,311.9 or \$.0035 per pound of added hominy-commeal where \$18.45 is the "$z - c$" value for rice bran (sign changed) and 5,311.9 is the coefficient in the hominy-cornmeal row (see Table VIII). Withdrawal of corn distiller's dried grains will increase the cost of the mix by \$2.13 ÷ 3,200.5 or \$.0007 per pound of added hominy cornmeal. Obviously, withdrawal of corn distillers dried grains is to be favored in this case.

The amount of corn distiller's dried grains that must be withdrawn before the negative hominy-cornmeal coefficient disappears can be easily determined. This is done by finding the percent that the negative hominy-cornmeal coefficient is of the coefficient in the hominy-cornmeal row of the corn distiller's dried grain vector, (i. e. 125.5 ÷ 3,200.5). The final adjustment consists of multiplying this percentage by each of the elements in

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[6] Actually the comparison should be extended to other ingredient and disposal processes including those with positive "$z_j - c_j$." Such comparisons were made in this instance and the other processes were found to be inefficient in providing increase in hominy cornmeal. This conclusion can be verified by reference to Table V. To simplify the exposition the details of these comparisons were not given since they exactly parallel those presented here.

TABLE IX. ADJUSTING MODIFIED SOLUTION TO CORRECT FOR NEGATIVE P_0 VALUE

Row vector identification	Modified P_0*	Corn distiller's dried grains vector	3.92% of corn distiller's dried grain vector**	Least-cost P_0 vector
Soybean oil meal	+ 10.8	+1,054.4	+ 41.3	+ 52.1
Barley	+203.3	+2,604.9	−102.1	+101.2
Oats	+231.4	+ 350.0	+ 13.8	+245.1
Hominy & cornmeal	−125.5	+3,200.5	+125.5	0
Fiber disposal	+ 15.1	+ 249.1	+ 9.8	+ 24.9
TDN disposal	+108.1	+ 65.1	+ 2.6	+110.7
$z_j - c_j$	− 50.63	− 2.13	− .08	− 50.71

* Taken from Table VIII.

** The ratio, 3.92% was developed by dividing the absolute amount of the negative level of hominy cornmeal by the hominy-cornmeal coefficient in the corn distiller's dried grain vector.

the corn distiller's dried grain vector and adding these computed coefficients to the previously modified mix vector given in Table VIII.[7] Table IX presents the data on this final adjustment. This modified P_0 vector plus the premix and the ingredients forced into the solution during the process of modification constitute the least-cost mix for the specifications given in Table I.

At this point it may be helpful to present the complete final mix. It consists of three parts—the premix, the ingredients added in the initial solution, and the ingredients indicated by the least-cost P_0 vector in Table IX. Table X presents and combines the three parts into a statement of the final mix. All the nutritional specifications except those for T.D.N. and fiber were exactly met. T.D.N. ran 110.7 pounds per ton over the minimum specifications as is indicated by the level of the disposal process in the final P_0 vector in Table IX. Fiber was 24.9 pounds under the upper limit permitted. This is indicated by the level of fiber disposal in Table IX. The cost of the mix is $50.71 per ton. To obtain the final cost, the original z_0 value was modified in the same manner as were the other P_0 entries.

A substantial amount of the data developed in this solution probably will be useful in the solution of "next-week's" problem. For example, assume that the only significant change to occur in the following week is a reduction in the supply of rice bran. All that would be required to obtain the least-cost mix for the new situation would be to subtract the appropriate proportion of the rice bran vector from the P_0 vector in the previous solution. This could lead to some further adjustment if one or more of the P_0 coefficients turned negative, but the additional work would be relatively small.

[7] In the process of making this kind of adjustment, it may happen that some other P_0 entry is forced to a negative level. This requires a separate determination of the optimum correction for this new negative element.

TABLE X. SUMMARY OF LEAST-COST MIX FOR ILLUSTRATIVE PROBLEM

	Source of entry			Final amount
	Premix	Added	P_0 of Table IX	
Soybean oil meal			52.1	52.1
Barley			101.2	101.2
Oats	100		245.1	345.1
Molasses	100	120		220.0
Wheat bran	200	100		300.0
Rice bran	100	100		200.0
Corn gluten feed		440		440.0
Corn distiller's dried grains	60	41.6		101.6
Wheat standard middlings	200			200.0
Salt	20			20.0
Dicalcium phosphate	20			20.0
Total	800	801.6	398.4	2,000.0

When more than one P_0 entry turns negative and no single ingredient is the best source of correction for all the negative coefficients, the adjustment is more complicated than the illustration given here. It is necessary in such cases to set up and solve a system of simultaneous equations to determine the optimum adjustment of the ingredients. In mixes of this simplicity the equation systems will be of low order. The use of a simplex analogue computer to solve equation systems for these and more complex mixes is being considered and offers promise.

The initial solution from which adjustments are made will eventually become obsolete.[8] The particular model used here would become obsolete by a sufficiently large decline in corn price relative to the other ingredients that may be used without limit. It can also be made obsolete if an additional ingredient becomes available. Specifications for ingredients or for the mix may also change and make the model obsolete.

When changes occur that make the model obsolete there are two alternatives that may be followed. First, a new "initial" solution can be obtained. Or, the existing "initial" solution can be modified to reflect the changes in the model. The choice between these alternative methods for obtaining a new model depends upon many factors. One of the chief factors is the extent of modification that is necessary. In the following sections some procedures are presented that are useful in modifying an initial solution to reflect model changes. Their presentation does not

[8] The model will remain usable but the degree of modification becomes increasingly complicated with obsolescence. For example, if "corn" came to have a negative "z − c" value, it would be necessary, using the existing coefficients, to enter corn until some row vector was forced to zero. Then the entry of the restricted ingredients would have to take into account the displacement of "corn" through the displaced row vector. This is intolerably complicated when a new solution including "corn" can be easily obtained.

mean that such modifications should always be attempted. In some cases it would be advisable to obtain a complete new solution.

Procedures for Modifying Initial Solutions

Adding ingredients to the problem

After the initial solution discussed above had been in use for some time an additional ingredient became available. This ingredient, "hominy," would have had the following vector in Table III had it been available at the time that this particular problem was set up.

Row vector identification	New "Hominy" column vector
Weight (T)	1
Protein	− 11.0%
Fat	− 6.9%
T.D.N. (#/T)	−1,690
Fiber	6.0%
Bulk (bu./cwt.)	2.5
Bulk variation	0

It is a great convenience to be able to express this ingredient in terms of the vectors of the initial solution shown in Table V. This can be done by first, multiplying each of the disposal vectors in the initial solution by the coefficient that the new vector would have had in the row occupied by the disposal process in the first tableau. Next, these products are summed across columns. In the case at hand, the weight disposal vector in the initial solution is multiplied by 1, the protein disposal vector is multiplied by −11.0 and so on.[9] The sum of these products for each row is the value for the corresponding coefficient in the "new hominy" vector of the solution tableau. This new vector can then be handled in the same manner as the other vectors of the solution. Table XI presents the details of this operation.

Changing an ingredient's specifications

If the protein level (or other characteristic) of a particular shipment of an ingredient differed drastically from that used in the initial model it would be necessary to correct for this change. This can be done by multiplying the protein disposal vector in the existing "initial" solution by the difference in protein level. Then the products are added to or subtracted from the column vector for this ingredient in the initial solution

[9] The "bulk variation" disposal vector was not included in the decoded solution tableau presented in Table V. This is of no consequence since the coefficient of the row is zero in each ingredient vector. The "T.D.N." and "fiber" disposal vectors were also omitted since their values are obvious.

TABLE XI. DEVELOPMENT OF COEFFICIENTS FOR A NEW INGREDIENT (HOMINY) CONSISTENT WITH SOLUTION TABLEAU COEFFICIENTS*

Row vector identification	Disposal Vectors × Coefficients from Hominy Vector**															Hominy vector in solution tableau
	[Weight disposal ×1]	+	[Protein disposal ×−11]	+	[Fat disposal ×−6.9 × 20]	+	[T.D.N. disposal ×−1,690]	+	[Fiber disposal × 6 × 20]	+	× [Bulk disposal 2.5 × 20]	=				
Soybean oil meal	(− 587.6)	+	(687.5)	+	(224.9)	+	(0)	+	(0)	+	(− 200.0)	=				124.8
Barley	(5,763.8)	+	(−1,038.4)	+	(−4,313.9)	+	(0)	+	(0)	+	(−1,465.0)	=				−1,053.5
Oats	(−4,226.9)	+	(114.4)	+	(− 171.1)	+	(0)	+	(0)	+	(4,260.0)	=				23.6
Hominy cornmeal	(1,050.7)	+	(236.5)	+	(4,258.7)	+	(0)	+	(0)	+	(−2,595.0)	=				2,950.9
Fiber disposal	(97.0)	+	(8.3)	+	(138.7)	+	(0)	+	(120)	+	(+ 292.8)	=				71.2
TDN disposal	(1,918.9)	+	(7.7)	+	(211.1)	+	(−1,690)	+	(0)	+	(− 444.5)	=				3.2

* Since the coefficients of Table V have been rounded to the nearest tenth, there is appreciable round-off error in these data.

** Fat disposal and fiber disposal were decoded to one pound per unit. Bulk disposal was decoded to one bushel per ton. In these cases it was necessary to multiply the coefficients by 20 to get them to the same magnitude as the ingredient coefficients.

to obtain a vector that is consistent with the new protein value. The same principle can be applied in case several changes occur in the ingredient's characteristics. This adjustment is applicable even though the ingredient may already be in the "initial" solution.

If the ingredient is in the premix an adjustment in the mix vector will also be required. This is an argument for putting in the premix only ingredients of consistent quality.

Changing the mix specifications

Those specifications that enter into the mix vector (see Table III) may be adjusted in a manner exactly parallel to that outlined above for the adjustment of ingredients. If the change is in the amount of a particular ingredient required or permitted, the change can generally be handled by reducing or increasing the level of entry of the processes blocked in the initial solution. If the change is one of either making freely available an ingredient that was previously limited or limiting an ingredient previously considered in unlimited quantity, it may be easier to rerun the problem from the beginning.

LAND TENURE AND AGRICULTURAL IMPROVEMENT IN TROPICAL AFRICA

H. A. Oluwasanmi
University College, Ibadan, Nigeria

DURING the past fifty years most of the old assumptions underlying indigenous social and economic institutions in tropical Africa have undergone radical and fundamental changes. This is the inevitable and logical result of the contact of two cultures. In many respects the changes are of such magnitude that old nomenclatures fail to describe adequately the resultant institutions. This observation is particularly true of tropical land tenure. New economic and social forces have registered themselves on the age-old system of tenure with a greater impact than elsewhere in the social system, partly because land is basic to the procurement of the elementary needs of life, and partly because land is more closely tied to the social and cultural values of the people.

The purpose of this paper is to examine the direction of change in the tenure systems and the forces influencing that change; to ascertain the precise nature of land policy in tropical Africa and the adequacy of such policy for agricultural improvement, and finally to suggest an alternative policy. The pattern of tenure in Nigeria will be used throughout as example.[1]

Direction and Forces of Change in Tropical Land Tenure

Communal land tenure, still the predominant form of land holding in tropical Africa, and the system of shifting cultivation commonly associated with it developed under conditions in which there was an abundant supply of land and the man-land ratio was relatively low. So long as the situations existed the only serious problem confronting the cultivator was that of the periodic selection of new sites for cultivation. This situation is, however, no longer static. We will examine briefly the economic and social forces at work in the changing pattern of tenure.

The partial commercialization of agriculture with its implication of conscious production of surpluses for the market—more especially production for the export market—introduced new elements into the traditional system of tenure. The cultivation of cocoa may be cited as an instance where production for exchange has modified customary land tenure. As a perennial, cocoa ties up land for a longer period than do the crops

[1] For comprehensive discussion of African land tenure see C. K. Meek, *Land Law and Custom in the Colonies*. London: Oxford University Press, 1949. Lord Hailey, *An African Survey*, London: Oxford Univ. Press, 1938. V. Liversage, *Land Tenure in the Colonies*, Cambridge Univ. Press, 1945. T. O. Elias, *Nigerian Land Law and Custom*, London: Routledge and Kegan Paul Ltd., 1953.

typical of subsistence farming. Since the right of the cultivator over trees planted by him is recognised under the traditional system of tenure, cocoa plantation means an indefinite interest on the part of the peasant in a plot of land and the abrogation of shifting cultivation.

Furthermore, the cultivator has the right to mortgage his crops (though not the land), or pledge them against indebtedness. At death the cultivator can also transfer the right over these cultivated trees to his heirs, thus indirectly impinging, or limiting the reversionary land rights to the community.

The growth of population in recent years has also affected old conceptions of land tenure. In Nigeria the population was calculated at roughly twenty million in 1931. Twenty years later the population has reached the thirty million mark. This unprecented upsurge in population means a drastic reduction in the period of bush fallow, and consequently, the deterioration of soil fertility. In some divisions of Owerri, Onitsha and Calabar Provinces of Eastern Nigeria where the density of population varies from 300 to 800 or more persons to the square mile, increased population has led to extreme fragmentation of holdings and the emergence of a quasi-individualization of tenure. In the circumstances, the cultivator not unnaturally regards his uneconomic holding as his absolute possession. The reversionary right of the community to this patch of land is however unimpaired by the process of fragmentation. In the event of death, or in cases where the cultivator and his family or their heirs fail to cultivate the land or use it in a manner beneficial to society, the right of the land-holding group to arrogate to itself rights of ownership remains unquestioned. This fact remains the true test of ownership in commonalty.

Social forces also combine with the purely economic forces to influence tenure practices in tropical Africa. The term "commune" in the indigenous society, especially as it relates to land matters, is coterminous with the extended family or the clan. The chief of the clan, or the head of the family was the sole authority in all matters pertaining to the administration of land. The emergence of new economic and social classes deriving their power and prestige from such unorthodox sources as material wealth and formal Western education has made a deep inroad in the authority of the tribal chieftain over land matters. As the traditional and narrower concept of "community" acquires greater flexibility in interpretation so also has the power of the tribal chieftain diminished. This breakdown in traditional loyalties reflects itself inevitably in the administration of land.

There are numerous cases in Nigeria in which one branch of an extended family, or a division of a land-holding group has alienated por-

tions of communal land without reference to other interested parties, and usually in defiance of customary usage and authority. Avaricious chiefs, rich and educated individuals of land-holding communities have been quick in grasping the changed economic conditions that are fast turning land into an economic good. Such individuals have in some cases used their superior knowledge and resources to acquire communal property for their private use.[2] This tendency to private appropriation of communal property is more widespread in the urban areas where the impact of trade and commerce has resulted in increased land values, and in the more densely populated areas where increasing population is slowly conferring upon land a scarcity value that it never possessed in the traditional system. Also English and other European legal ideas have intruded upon the traditional tenure system. In many urban areas in Nigeria, notably Lagos, Port Harcourt, Ibadan, Aba and Onitsha the English concept of individual ownership in land has become the rule rather than the exception. In these urban areas land is freely transferred by sale, mortgage or lease. This practice is slowly extending to the rural areas.

It is clear from the foregoing that the growth of an exchange economy, pressure of population, foreign legal ideas and the introduction of new types of crops constitute the major influences in the changing pattern of African land tenure. Whatever influence the slave trade, the two World Wars, the infiltration of Americanism, monotheism, adult suffrage and fiscal policy might have exerted in the growth of individualism in tropical Africa, a closer examination of the facts compels us to conclude that the effects of these forces on land tenure have been peripheral and indirect.[3] The changes in land tenure, especially the tendency towards individual holding, are direct and spontaneous reactions to new economic and social forces. These changes, together with the incipient growth in certain areas of the country of capitalist land-owners, call for a thorough appraisal of present land policy to determine its adequacy for agricultural and economic development.

Land Policy

In Nigeria and in other parts of British tropical Africa official policy has long reconciled itself to the Lugardian theory that economic progress, more especially agricultural improvement, is synonymous with the progres-

[2] See L. T. Chubb, *Report on Ibo Land Tenure*, Zaria (Nigeria): Gaskiya Corporation. Mr. Chubb cited numerous instances of educated members of land-holding families among the Ibos acquiring family land for private purposes by dubious and one-sided agreement. See pp. 26-36.

[3] See D. C. Igwe, "The Need for Enclosure and Land Resettlement in Nigerian Agriculture," *Tropical Agric.* Vol. 3, Jan. 1954. Mr. Igwe considers these the most important forces leading to individual ownership in land.

sive individualization of tenure. Freehold right in land was and is still considered a natural evolution from primitive collectivism to individual enterprise; in addition, it is believed that individual right in land "would so effectively tend to emancipate the peasant class from the servile attitude of mind which long generations of slavery had induced in them. . . ."[4]

The assumed superiority of individual right in land over communal ownership can be validated only when it can be conclusively demonstrated that the former has superior economic and social advantages that are lacking in the latter. Such conclusive proof of superiority is yet to be advanced by the advocates of individual rights in land. Instead, it must be observed that communal tenure enjoys certain inherent social advantages that are absent from the individual forms of tenure.

From the purely social standpoint communal tenure acts as a strong cohesive force in an agrarian society. The system affords the cultivator a stake in the major assets of the community and assures him a secure place in society. By banning sale of land the system precludes the rise of a landed aristocracy and thereby removes much of the source of social unrest inherent in the landlord-tenant relations elsewhere. In India and most Middle East countries a system of peasant proprietorship has been in operation for many years. The heavy indebtedness of the peasantry to middlemen and money-lenders in these countries raises doubt as to the ability of individual tenure with its unbridled freedom of transfer by sale to emancipate the peasant from serfdom.

To determine how efficiently a given system of tenure performs its economic functions it is necessary to know whether under that system land is utilized in such a way as to give maximum yield and maintain the soil in "good heart." Given an abundant supply of land, sparse population and subsistence farming, communal tenure constitutes no insurmountable hinderance to the attainment of sustained maximum yield. The system recognizes the need for maintaining fertility and assures this by providing for a long period of fallow during which the soil regains its fertility through the process of natural regeneration. But as we have already seen these assumptions are undergoing tremendous changes. For instance, increases in population have introduced some of the worst defects of any agricultural organization, notably soil mining and excessive subdivision. Soil mining is not confined to communal forms of land holding; but the process is accelerated in a communal system where as a result of population pressures the period of fallow is considerably reduced.

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[4] F. D. Lugard, *Political Memoranda*, London: Waterlow & Sons Ltd. 1919, p. 347.

Towards a New Land Policy

As a result in the change in the economy of Nigeria the old system of tenure has become a slow, ineffectual, and inadequate vehicle of effecting fundamental changes in agricultural practices. It is therefore vitally important to evolve a system of tenure that will preserve all that is best in the old system and permit at the same time the introduction of innovating techniques in agriculture. As a prerequisite to evolving a more satisfactory system of tenure the concept of ownership and control needs to be re-examined in the light of changing social conditions. This is particularly true of the ownership and control of uncultivated bushland.

The table of land utilization shows that 81 per cent of farming land

LAND UTILIZATION IN NIGERIA—PERCENTAGE OF TOTAL AREA DEVOTED TO VARIOUS USES, 1950–51[5]

Land Use	Nigeria & Cameroons	Northern Region	Western Region	Eastern Region	British Cameroons
Farm crops	8.8	6.8	9.0	20.6	3.2
Tree crops	1.2	—	7.0	2.7	1.3
Forest reserve	7.5	5.7	12.3	8.4	6.3
Nonagricultural	0.9	0.8	0.6	1.4	0.6
Uncultivated bush and fallow	81.3	86.7	71.1	66.9	84.9

in Nigeria is uncultivated bush and bush fallow. The ownership and control of this waste is of the greatest importance to the improvement of agriculture in Nigeria. Every square inch of land, including the uncultivated bushland, is claimed by some group, even though such claimants cannot hope in the next generation or two to bring a single acre of their claims under the hoe. Under the existing system of tenure the use of the uncultivated bushland is denied to enterprising individuals. The community itself is denied a share of any increased value that may have accrued to such bushland in the general progress of society.

Within the traditional framework of tenure the responsibility of the community over land is clear and unmistakable. In the "tribe-state," authority in land matters is vested in the head of the family or in the chief of the clan. One of the most significant facts in tropical Africa today is the rapidity with which larger territorial aggregates are supplanting tribal units. These new entities are acquiring the political and social functions once performed by the tribal authority. It follows inevitably that for an orderly economic development the "nation-state," as the logical heir to the fast-disappearing tribal order, should acquire one of the

[5] Source: Nigeria Dept. of Statistics, *Report on the Sample Census of Agriculture*, 1950-51, Lagos, 1952.

latter's most potent responsibilities—responsibility over land matters. The state as the communal landlord should be vested with authority over uncultivated bush and waste. It should be in a position to utilize the uncultivated bushland in much the same manner as the tribal authority disposed of virgin land.

The system of ownership advocated here will preserve in the larger social aggregate the beneficial features of the communal system; in addition, it will enable the government to "enclose" large areas of unused land for resettlement and other agricultural projects without paying the heavy compensations now required under existing legislation. Lugard's argument in favour of government control of uncultivated bushland still constitutes the most eloquent statement of the problem extant:

"It is not necessary to demonstrate that the development and the assignment of such lands should be controlled by Government. It often happens that a Village Community, or even a whole tribe, dwindles in population while its neighbour may be rapidly increasing till there is not enough land to provide for its actual food requirements. The necessary adjustments were in former times made by inter-tribal war, accompanied by the extermination and enslavement of the weaker. Under British rule such arbitrament has ceased, and it follows that the Suzerain power must in such cases exercise supreme control over land, which has become waste, even though it may disclaim any right to interfere with the titles to occupied land."[6]

In order to solve this conflict between the claims of the tribal group and the larger social aggregate—a conflict that is bound to assume a more violent character as society progresses—the state must arrogate to itself, through legislative enactments, the ultimate and radical ownership in land. The Land and Native Rights Ordinance of 1910 was aimed at achieving in Northern Nigeria the objective of vesting all rights in land in the "Crown," which will exercise this right on behalf of the people exactly as was done by the tribal authority. The law as amended in 1916 rendered it unnecessary for "Goverment to establish or register its title to any lands it might hypothecate for public or lease to Aliens, or to pay for them otherwise than by way of compensation for 'improvement'."[7] This law applies only to the Northern Region of Nigeria. As a result the acquisition of unused, though claimed, land for agricultural and other economic purposes is made possible in Northern Nigeria without incurring heavy expenses.

Land policy in the immediate future must accept the desirability, and indeed the urgency, of extending the provisions of the 1916 Ordinance to the Southern Provinces of Nigeria. For some time to come, general economic development in Nigeria, and in most of tropical Africa for

[6] F. D. Lugard, *Ibid;* p. 340.
[7] F. D. Lugard, *Ibid;* p. 351.

that matter, will revolve around agriculture. The correctness of this view is easily demonstrated by the simple fact that the success of industrialization—the presumed universal panacea dear to the heart of leaders in underdeveloped countries—will depend, at least in the initial stages, on a highly productive agriculture. The impecunious peasant farmer with his three-acre holding and deeply ingrained habit of shifting cultivation appears a very unlikely vehicle for accomplishing the urgent changes desired in agricultural methods and agricultural productivity in tropical Africa.

Government-sponsored resettlement schemes such as the one in the Shendam Division of the Plateau Province of Northern Nigeria, and large-scale plantations on the magnitude of the Apoje project sponsored by the Regional Production Board of Western Nigeria will increasingly become the instruments for capitalizing tropical agriculture and of introducing new and better methods of cultivation. When fully evolved, it is proposed that the projects will confirm the rights of the individual tenants in their holdings—holdings now farmed on the basis of permanent and improved methods of husbandry. These holdings will be heritable but their transfers will be subject to state control. Thus the communal features of the old system are combined with improved agriculture.

"Enclosure" as conceived here differs from compulsory registration of titles to existing holdings. What is intended here is free and unfettered access to the uncultivated bushland by the state which, under the existing economic conditions in the underdeveloped tropics, must continue to be the prime mover of projects of agricultural improvement. Registration of titles to the three-acre peasant holdings, or what is called "enclosure" by certain writers will not of itself compel the peasant producer to adopt improved methods of husbandry.[8] As long as he is free to range over the uncultivated bushland as heretofore, there will hardly be any incentive for him to cultivate grass and legume as fallow crops, or to accept the arduous task of tending livestock. It would indeed be premature "to tie down cultivators to fixed areas until we can indicate to them with confidence agricultural methods which are likely to yield better returns."[9]

But as conscious resettlement schemes and plantation projects encroach on the wild domain and reduce the area within which the shifting cultivator can operate, the peasant farmer will be induced either to leave his land and accept wage employment on the plantations or adopt permanent cultivation. In addition, the superior economic conditions of the farmers in the settlement schemes and on the plantations will act as a powerful incentive to the individual proprietor to emulate the example of his neigh-

[8] For a contrary view see D. C. Igwe, *Ibid.*

[9] Lord Hailey, *An African Survey*, London: Oxford University Press, 1938, p. 869.

bours. Unless the government and enterprising individuals can colonize the bushland without the burden of excessive compensation the process of introducing innovating techniques in agriculture is bound to be slow and socially costly.

It may be argued that the provisions of the Land Acquisition Ordinance of 1917 (later amended in 1945) are adequate for meeting the acquisition of land, occupied or unoccupied, for public purposes in Nigeria. In fact, this law proscribes the payment of compensation for "unoccupied" land. As we have seen there is no land, however derelict, without a claimant. There is therefore no "unoccupied" land in Nigeria. This fact has saddled society with heavy burden of compensation for land acquired for public purposes. This burden will grow as the very progress of society confers added values on the uncultivated bushland that now forms more than two-thirds of the total area of Nigeria. Heavy compensation for uncultivated bushland is a powerful deterrent to government and enterprising firms and individuals in undertaking projects of agricultural improvement.

THE UNIT FARM AS A TOOL IN FARM MANAGEMENT RESEARCH

A. L. Jolly
Imperial College of Tropical Agriculture, Trinidad, B.W.I.

UNIT farms have been used at the Imperial College of Tropical Agriculture, Trinidad with unique success for the investigation of management problems of peasant farming.[1] Although the technique has been attempted in a number of other places it has to the writer's knowledge never before been carried through to a successful conclusion. The lack of success has usually been due to a faulty experimental technique and confusion as to the objectives and conditions of the investigation. As a result unit farms as a method of management research have received less attention from the economist than they probably merit.

The requirements and procedures for a satisfactory unit-farm investigation have after 10 years' experience in Trinidad now been fairly clearly defined. They have already been reported in detail.[2] Briefly, they are designed to enable the investigator to exercise complete control over the farm on which he is experimenting. His control is not only in respect to agricultural techniques, but also in the more fundamental features of labour organisation, capital investment, enterprise combination, intensity of application of resources, and so on. By proper accounting the investigator can collect all the facts about the operation with a given organisation. He can control and examine any reorganisation he may think desirable in order to achieve an economically more efficient farm.

An example of a problem that could have been investigated by unit farms is furnished by some studies[3] recently carried out in the United Kingdom as to the effect of improved grassland management on farm productivity. The fundamental scientific proposition is simply that heavier and more scientific application of fertilisers to grassland could provide more abundant and cheaper feed for cattle. The problem was investigated by using selected commercial farmers who were willing to co-operate and act within the advice of the economist who was keeping accounts on operation. In every case the farms underwent considerable reorganisation in respect to numbers and kind of livestock kept, acreage of crop land, extent and method of silage making, fencing and rotation of pastures, etc., in order to exploit the possibility of better grassland management. However, it was not certain that they were reorganised as rapidly or as

[1] A. L. Jolly, *Economic Series 2, Peasant Farming. Report on Peasant Experimental Farms at the Imperial College of Tropical Agriculture*, Trinidad, B.W.I., 1954.
[2] A. L. Jolly, *Economic Series 3, Readings in Small-Scale Farming*, 1956.
[3] Imperial Chemical Industries Ltd., *Milk from Leys in the Weald of Sussex*, Bul. No. 6, I.C.I., Ltd., London, S.W.1. 1955.

radically as they should have been to exploit the possibility to the full. If this problem were being investigated by means of unit farms, commercial farms would not have been used. Farms would have been purchased and financed by the investigators and the operation delegated to a salaried manager. The unit might well be a unit of land, but other restrictions probably would be imposed, such as the maximum capital value of the farm. The investigators, who had complete control of the planning and replanning of the farm within these restrictions, would be able to pursue their investigation unhindered by, for instance, the actual earnings in a particular year when reorganisation was in progress.

Experience has shown that such economic experimentation is quite feasible and can yield very satisfactory results. For instance, every one of the five unit farms so far investigated in Trinidad required reorganising from the first plan and sometimes more than once. Redundant capital was written off, new replacement capital was written in. These changes were necessitated by the inefficiency of the original organisation as shown by the accounting data collected in the early years of operation. In the process the efficiency of the farms, especially in respect of labour utilisation which was of the greatest importance in these particular experiments, was increased from two- to five-fold.

The need for such well controlled farm management experiments is generally underestimated particularly in the tropics. Agricultural science is concerned essentially with the technical details of farming and not with the organisation of them into an efficient farm business. The scientist assumes that any improved technique is of benefit to every farm that is concerned with the particular crop or class of livestock he has been improving. The scientist cannot judge with any accuracy, nor for that matter is he greatly concerned, how important a new technique may be to the operation of the farm or how its introduction will affect the farm organisation in other respects. To him every isolated improvement is another brick in the building of more efficient agriculture. In reality, however, every improved technique affects the whole structure of a farm. Its introduction does not represent the laying of a brick on top of a building, but the removal of one part way down and replacing it by a better one. This replacement can be as disturbing to a farm as to a building.

Wherever agriculture is technically less advanced the effect of any single innovation is likely to be even more fundamental and the need for subjecting it to economic tests within a farming system is even greater. The admirable work done by veterinary officers in the tropics has unfortunately led in some areas to an actual deterioration in agriculture through overstocking. Animal health has been regarded rather as an object in itself and has been dissociated from the management of any

particular type of farm. Similarly the introduction of a cash crop into a typical subsistence farming district, although it may by itself represent a technical and economic advance, may result in a deterioration in the agriculture. The danger is overconcentration on that one crop to the destruction of a more balanced and therefore more permanent and flexible form of agriculture.

The primary function of the farm management economist should be to study the repercussions of technical innovations on farm organisation; some economists, particularly those who are concerned with less-developed areas, might go further to say that their function is to select combinations of enterprises and practices from the fund of scientific knowledge that will make a more efficient use of the economic resources available. Whatever the degree of function, the economist is generally faced with the difficulty that he has no laboratory in which to carry out experiments in organisation. The classical tools of economic research are designed essentially to measure conditions as they exist and changes as they occur. From the data so collected theories can be formed about the causes of certain conditions and the changes required for further improvements in efficiency. But these analyses are largely theories and it is often difficult to prove whether they are correct merely from the observation of subsequent trends that occur. Indeed, the classical tools offer little opportunity for putting theories of management to a practical scientific test.

The role that the agricultural economist is all too frequently required to play, if he has no unit farms to aid him, may be illustrated by the introduction of an improved harvesting machine. The farmer usually first learns of such a machine through the manufacturer's sales organisation—advertisements, shows, booklets, field trials and demonstrations, etc. He will buy it most commonly because it is claimed to harvest more quickly and with less labour and therefore apparently more cheaply than previous machines. The new machine, however, is cheaper only if the time and labour saved by its use can be productively applied either in growing more of the particular crop handled or in producing more of something else. When the farmer brings it home he is faced with a hundred and one management problems of reorganisation to make the best use of the novelty and in fact realise its potential saving in costs. Gradually the more progressive and ingenious farmers solve these problems and the machines come into restricted use. Only at this stage can the economist commence his studies and establish principles of farm organisation suitable for the efficient use of this machine. He is powerless with his traditional tools of research to pioneer its invention and introduction or to accelerate these processes by prior scientific investigation. His role is more a commentator

on and an analyst of agricultural progress than one of its pioneers.

Admittedly the classical means of investigation have stimulated agricultural efficiency, and efforts are constantly being made by economists to broaden their application. The survey method is most useful in bringing to the notice of farmers the wide difference in efficiency between the best and worst among them. Some surveys are capable of demonstrating in considerable detail how the most efficient achieve their good performance. The less efficient can and have been stimulated by such reports. The accounting approach to farm management research can give even more detail about the working of individual farms and so stimulate farmers not actively participating in such a scheme to consider their own farm organisation much more critically. The accounting study also allows the economist to give the participating farmer detailed and practical advice as to the opportunities of improving his management. According to how much this advice is acted upon, the economist in fact becomes part manager and developer of such a farm.

Recently the writer has come in contact with a further extension of the economist's participation in the management of individual farms by means of the accounting approach. The study is worth mentioning as demonstrating possibilities and limitations of this method. A federal agency has been assisting a number of farms in the United States with credit on condition, among other things, that they keep satisfactory accounts and act upon the advice of county agents and district economists in utilising these development loans. The farms the writer visited were obviously making good use of the available funds and considerable economic and technical progress had been achieved. Nevertheless, they were not proving ideal as material on which to make management experiments. The difficulty was that the farmers were liable to the agency for the funds advanced and, although promising lines of development had emerged (different on each farm and somewhat different from the original plans), the farmers were not prepared to incur the further financial obligations required to put these developments to the test. Future developments would have to proceed much more slowly because of effective shortage of capital. Such of course is a practical difficulty of farming but is an unnecessary handicap in developing model farm organisations. The economist is placed in much the same position as a chemist with a limited number of flasks. When they are all broken his experiment is finished regardless of the scientific progress of the experiment. One principle of work on unit farms is that the operator, who is responsible only for putting into practice the ideas of the economist, must be in no way concerned with the financial results of the experiment. When a satisfactory system has been evolved it will be possible to calculate the

capital required to establish it quite separately from the expenses of the experiments that have been required to evolve it.

The unit farm offers an entirely new approach in that all factors of management and organisation are under the economist's control. With such a research tool it is possible for the economist to move ahead of existing farm organisations and, it is to be expected, produce some far more efficient ones than currently practised. He would thereby have the opportunity of revolutionising farm management and organisation. The need for such a revolution is most acute in the tropics; but there are nevertheless opportunities that are not always appreciated in temperate countries possessing already well developed agriculture.

In the tropics, agriculture has developed in the last 100 years mainly on the large unit, one-enterprise plantation. Such an organisation has led to a tremendous increase in production and productivity, but it obviously possesses limitations from the point of view of future development in being confined to one type of farm. Small farmers by and large have improved their position by imitating plantation production and using marketing facilities created for the large unit. Such imitation restricts development even more severely and although generally more efficient than subsistence farming exhibits many glaring inefficiencies. So far there has been little development in really efficient systems of farming suitable for the small farmer and medium-sized farmer in the tropics. It appears rather unlikely that they will evolve naturally because the plantations have become so large, so specialised and so far in advance technically of other farm types. The economist with the aid of unit farms can pioneer entirely new small-scale systems of farming that are most desperately needed in the tropics.

The scope for the improvement of farming in more developed countries by means of unit farms lies chiefly in experimenting with systems that are not practised usually because of the supposed risks involved. For instance, farmers are always nervous of over-specialisation and it is probable that farming generally remains too diversified for the maximum efficiency. Unit farms can prove over the course of years how great this danger is in any particular line of production and what increased efficiency is achieved by specialisation. In the same way individual farmers (and bankers too for that matter) are cautious about relying too heavily on credit, and it is possible that farming generally is undercapitalised. The writer is well acquainted with one agricultural industry (cocoa farming) where the accepted standards of capitalisation by planter and banker alike are far below the technical possibilities of the crop. It is possible by means of unit farms to investigate how far additional capital can be productively used and so stimulate the more rational attitude of

both borrower and lender in the financing of that type of agriculture.

None of these possibilities is likely to be achieved by the agronomist, or by the economist unequipped with a unit-farm laboratory in which to work. The agronomist by and large has been too severely trained in natural sciences and is to interested in the biological processes of farming to be a good experimenter in farm management and farm organisation. He can and should be an essential adviser to the economist but he should not pioneer farm management experiments. The economist without the unit farm is too much at the mercy of human, financial and physical conditions as they exist in commercial agriculture to have a free hand in investigating the possibilities of management that occur to him. The unit farm provides him with the essential tool for putting his theories to the practical test.

APPLICATION OF INPUT-OUTPUT MODELS TO AGRICULTURE*

EARL O. HEADY AND JOHN A. SCHNITTKER
Iowa State College

PROBLEMS of the agricultural economy and their solutions increasingly spring from its interrelations with other sectors of the national economy. Few attempts have been made to describe and predict these interrelationships. Input-output analysis is one simple descriptive tool that can be used for this purpose.[1] Its usefulness as a predictive devise is not fully established.[2] The technique probably has not been used with emphasis on agriculture (a) because it appears to be a complicated technique and (b) because it has, as do most techniques, limitations in projections away from a given point in time. The purpose of this paper is to outline the simple logic and computational steps of input-output analysis. The results from a simple model are also presented. There are alternative methods by which interrelations of various sectors of the economy can be studied.[3] It is not the purpose of this paper to weigh the detailed advantage of each. However, a brief review of the restrictions and limitations of input-output analysis is included.

Requirements and Nature of Analysis

Input-output analysis involves mathematics scarcely beyond simple arithmetic. Any person interested in the method can understand the matrix algebra in a period of two or three days study. Mathematics is not the greatest difficulty in input-output analysis. Final calculations involving matrix inversion can be made in a very short time. They are relatively inexpensive, even where a machine is hired for a problem with up to 30 to 40 sectors. The larger cost, both in time and funds, is clerical in assembling data from the census and other sources. Usefulness of results depends more on this unromantic process of assembling data than on intricacies of mathematics. The main work is not unlike a purely descriptive analysis of census data. As a guide for efficient clerical work, however, it is important that the model of the relevant sectors and aggregation procedures be set forth explicitly. Unfortunately, secondary data for this and similar aggregative analyses is far from perfect. Subjec-

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[1] See, as a basic reference, W. W. Leontief, *Structure of the American Economy*, 1919-1929, 2nd Ed., New York: Oxford University Press, 1951.

[2] See especially, National Bureau of Economic Research, *Input-Output Analysis, An Appraisal*, Princeton: Princeton University Press, 1955.

[3] For example see, L. R. Klein, *A Textbook of Econometrics*, Evanston: Row-Peterson, 1953.

tive judgment supplements data at every step in deciding which inputs and outputs can be meaningfully thrown into one category.

Clerical and Arithmetic Steps

If a preliminary model defining the sectors of the economy whose transactions are to be analyzed is given, the clerical steps can be initiated. These two steps are not, of course, independent: model building is a continuous process. The clerical opportunity for disaggregating data of particular economic strata determines which unique sectors can be meaningfully analyzed. The sectors finally selected for analysis will define the clerical steps to be used in collecting and aggregating the data from the various sources. After the sectors (industries or segments of industries) have been decided on, the first clerical step is assembling the inputs (value of materials and services) that one particular sector draws or uses from each other sector. Conversely, this process is one of dividing the total output of one sector into the parts that go to other sectors. Suppose that the sectors are designated by numbers and that we have sectors 1, 2, 3, 4, . . . n; where 1 may be Midwest agriculture, 2 may be New England agriculture, 4 may be the farm machinery industry, n may be the transportation industry, etc. We can then designate the output of these sectors as $X_1, X_2, X_3, X_4, \ldots X_n$, where X_1 refers to the total output (value of) Midwest agriculture, X_2 refers to the total output of New England agriculture, X_n refers to the value of service output by the transportation industry, etc. In other words, clerical operations first include computation of the total value of output, X_i, for Midwest agriculture. The same step is repeated for each other sector. Next, clerical operations are used to determine what part of the output of one industry or sector moves to (is an input for) each other industry or sector. Thus we designate x_{12} as the amount of output from sector 1 used by sector 2 (i.e., the absolute amount of X_1 which goes to X_2), x_{24} as the amount of product from sector 2 used by sector 4, etc. In general, these input quantities are designated as x_{ij} where i refers to the sector producing the input and j refers to the sector using it (i.e., the i represents the row of the input-output table, system of equations or matrix and the j representing the column). The next clerical step is to compute the absolute amount of the product from each sector which moves into final consumption (i.e., final demand or bill of goods) without moving through the other industrial sectors. Final demand can include direct consumption by households, government, foreign trade, or similar segments of the economy which are defined to be *autonomous*. Thus we compute $Y_1, Y_2, Y_3, Y_4, \ldots Y_n$, with Y_i representing the amount of X_i "consumed directly." A table of total inputs (flows) and outputs, such as the one below, then exists:

INTERSECTOR FLOWS OF GOODS AND NET OUTPUTS

		Sectors using (X_j)						Final demand (Y_i)	Total output (X_i)
		1	2	3	4		n		
Sector producing (X_i)	1	x_{11}	x_{12}	x_{13}	x_{14}	$\cdots$	x_{1n}	Y_1	X_1
	2	x_{21}	x_{22}	x_{23}	x_{24}	$\cdots$	x_{2n}	Y_2	X_2
	3	x_{31}	x_{32}	x_{33}	x_{34}	$\cdots$	x_{3n}	Y_3	X_3
	4	x_{41}	x_{42}	x_{43}	x_{44}	$\cdots$	x_{4n}	Y_4	X_4
	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.
	n	x_{n1}	x_{n2}	x_{n3}	x_{n4}	$\cdots$	x_{nn}	Y_n	X_n

In the main body are included the x_{ij} quantities, indicating across the top the (j-th) sector using the quantity and along the left side the (i-th) sector producing it. (The values x_{ij} for $i = j$ will be zero or blank if output is defined on a net basis and an intrasector flow is not indicated.) For example, the number in the cell of the first row and second column (x_{12}) is the quantity of output from sector 1 which is used by sector 2. In the next to last column, Y_1 is the quantity of output from sector 1 moving directly into consumption; X_1 is the total output of sector 1, etc. From this basic table can be establishing the system of equations in (1) below:

$$
\begin{aligned}
X_1 - x_{12} - x_{13} - x_{14} \cdots - x_{1n} &= Y_1 \\
-x_{21} + X_2 - x_{23} - x_{24} \cdots - x_{2n} &= Y_2 \\
\cdot \quad \cdot \quad \cdot \quad \

From these calculations, it is evident that $x_{ij} = a_{ij}X_j$. In other words, $x_{12} = a_{12}X_2$, meaning that the total quantity of output from sector 1 used by sector 2 is equal to the amount of sector 1 used per unit of output from sector 2, multiplied by the total output of sector 2. Calculation of the input-output coefficients makes possible the substitution of the $a_{ij}X_j$ quantities for the x_{ij} quantities in the equations of (1). The result is the system of equations in (3) which involve only elementary arithmetic. Again, they say: the amount of product from one (the i-th) sector moving into direct consumption (Y_i) is equal to the total output of that sector (X_i) minus the sum of the products

$$\left(\sum_{j=1}^{n} a_{ij}X_j\right)$$

formed by multiplying the input-output coefficients (a_{ij}) by the total output of the consuming sectors (X_j). Although only arithmetic is involved to this point, the algebra of computations now begins:

$$\begin{aligned}
X_1 - a_{12}X_2 - a_{13}X_3 - a_{14}X_4 \cdots - a_{1n}X_n &= Y_1 \\
-a_{21}X_1 + X_2 - a_{23}X_3 - a_{24}X_4 \cdots - a_{2n}X_n &= Y_2 \\
\vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots &\quad \vdots \\
-a_{n1}X_1 - a_{n2}X_2 - a_{n3}X_3 - a_{n4}X_4 \cdots + X_n &= Y_n
\end{aligned} \tag{3}$$

In the notation of matrix algebra, (3) can now be written in the manner of (4).

$$\begin{bmatrix}
a_{11} & -a_{12} & -a_{13} & -a_{14} \cdots & -a_{1n} \\
-a_{21} & a_{22} & -a_{23} & -a_{24} \cdots & -a_{2n} \\
\vdots & \vdots & \vdots & \vdots & \vdots \\
-a_{n1} & -a_{n2} & -a_{n3} & -a_{n4} \cdots & -a_{nn}
\end{bmatrix}
\begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} =
\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} \tag{4}$$

The figures in (4) are copied directly from (3), but are simply *put in different form.* By the rules of matrix algebra, (4) has exactly the same meaning as (3). Three matrices (arrays of numbers in a particular order) have been set up in (4). There is a matrix of the input-output coefficients (with a_{11}, a_{22} etc., for all a_{ij}'s where $i = j$, equal to 1 where intrasector flows are not considered) in exactly the order of (3). Also there is a matrix or vector of total outputs, with the row order transposed into a column of the same order, and a matrix or vector of the quantities used in direct consumption, in exactly the order shown in (3). The algebraic system of (4) says that if we multiply the matrix of input-output coefficients by the matrix of total outputs, we obtain the amounts of each producing sector moving directly ino final consumption. This is exactly what the arithmetic system in the equations of (3) states. In fact, (3) can be derived directly

from (4), as well as vice versa. In matrix multiplication, we multiply the element or number in the first row of the first matrix by the corresponding element or number in the column of the second matrix, and add the quantities to give the corresponding element or number in the third (product) matrix. Using this rule, we obtain $a_{11}X_1$-$a_{12}X_2$-$a_{13}X_3$-$a_{14}X^4$ . . . . $-a_{1n}X_n = Y_1$, the first equation of (3), by multiplying the first row of the first matrix by the column of the second matrix. Then by multiplying the second row of the first matrix by the column of the second matrix, the second equation of (3) results; etc. The only purpose of this explanation is to show that (4) is the equivalent of (3), and, hence, to allow further calculations to be based on the concepts of (4).

One of the goals of input-output analysis is to relate output of one sector to final or direct consumption of the output of other sectors (i.e., to express output of producing sectors as a function of final demands). The equations of (3) do not show this, but rather indicate the amount of Y_1 remaining with particular outputs of the various producing sectors (i.e., express the final bill of goods as a function of output in producing sectors). The task is to use the data of (3), and hence (4), in expressing the relation of production in one sector to the final demand for products of the various sectors or industries. To facilitate the presentation, the "abbreviations" in (5) are used for the quantities in (4). That is, we let A represent the matrix of input-output coefficients; X the matrix of total outputs; and Y the matrix of final demand quantities.[4]

$$AX = Y \tag{5}$$

In simple arithmetic or algebra, we could predict the value of X, for any change in Y by simply dividing each side of (5) by the reciprocal or inverse of A

$$\left(\text{i.e., } \frac{1}{A} \text{ or } A^{-1}\right) \text{ to give } X = \frac{1}{A}Y \text{ or } X = A^{-1}Y.$$

However, since A, X and Y are "abbreviations," not for a single number each but for an entire array of numbers, this simple division, cannot be used. Matrix algebra requires multiplication by an inverse matrix, rather than division. Hence, if we let A^{-1} represent the inverse matrix of A in (5), the elements of X can be computed as in (6) and hence (7). In (6) we multiply each side of the equation by A^{-1}, the inverse of matrix A. A given matrix multiplied by its inverse

$$A^{-1}AX = A^{-1}Y \tag{6}$$

$$X = A^{-1}Y \tag{7}$$

[4] Each of these abbreviations represents a matrix of the entire array of numbers in (4) and the product of the first two matrices involves the multiplications of individual numbers or elements as explained for (4), to obtain the values in (3).

gives a product "equivalent" to I (i.e., an identity matrix). Thus (7) is derived from (6): stating that the values of X (the output of particular sectors) can be derived by multiplying the quantities of final demand by the inverse of the matrix of input-output coefficients. Hence, once the quantities of (4) are established, purely clerical or arithmetic step, equation (7) can be established to relate the X_i values (the output of particular sectors) to knowledge of input-output coefficients and the final bill of goods, or final demand. However, since (7) is in "abbreviated" or symbol form, we use its equivalent form in (8). In this case, we have substituted a matrix with elements (c_{ij}) to represent A^{-1}. If we multiply these elements by those representing final demand quantities (Y_i), we can "predict" the X_i values (output of particular industries or sectors). Just as the two matrices in (4) can be multiplied to give the set of equations in (3), the two matrices in (8) can be multiplied to give the set of equations in (9). Hence, if we know the elements of the inverse matrix of the input-output coefficients, we can multiply them by the quantity moving into direct consumption from each sector (Y_i) and predict total output of each sector. We multiply the first row of c_{ij} values (i.e., c_{1j}) times the Y_i values, the sum of these quantities being equal to X_1. The same procedure is used for X_2, except the Y_i column (vector) is multiplied by the second row of c_{ij} values (i.e., c_{2j}), etc.

$$(8) \qquad \begin{bmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ X_n \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} & c_{13} & c_{14} \cdots & c_{1n} \\ c_{21} & c_{22} & c_{23} & c_{24} \cdots & c_{2n} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ c_{n1} & c_{n2} & c_{n3} & c_{n4} \cdots & c_{nn} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ \cdot \\ \cdot \\ Y_n \end{bmatrix}$$

$$(9) \qquad \begin{aligned} c_{11}Y_1 + c_{12}Y_2 + c_{13}Y_3 + c_{14}Y_4 \cdots c_{1n}Y_n &= X_1 \\ c_{21}Y_1 + c_{22}Y_2 + c_{23}Y_3 + c_{24}Y_4 \cdots c_{2n}Y_n &= X_2 \\ \cdot \qquad \cdot \qquad \cdot \qquad \cdot \qquad \cdot \qquad &\cdot \\ \cdot \qquad \cdot \qquad \cdot \qquad \cdot \qquad \cdot \qquad &\cdot \\ c_{n1}Y_1 + c_{n2}Y_2 + c_{n3}Y_3 + c_{n4}Y_4 \cdots c_{nn}Y_n &= X_n \end{aligned}$$

The c_{ij} values are called interdependence coefficients in input-output analysis. Each c_{ij} shows the amount of the net output of sector i, associated with one unit of the output of sector j going to final demand. The interdependence coefficients "tie together" the entire economic system, relating output of one producing sector (a) to final consumption or demand and (b) to output in other producing sectors. The system reflects not only the amount of output in a *particular* sector necessary to provide for direct consumption or final demand of this same sector, but also the indirect effects on output in the *particular* sector in relation to final demand for output of other sectors. For example, the coefficients c_{1n} and c_{2n}

might express the effect of final demand for automobiles (Y_n) on the output of hides for leather (X_1) and soybeans for plastics (X_2) by agricultural sectors. But, given the appropriate model, indirect demand also would be reflected back to the agricultural sector through other sectors. Output of autos requires output of machine tools which might come from an industry using soybeans for plastics in some of its equipment.

Thus the main mathematical task is computing the interdependence coefficients. It is not necessary to set down equations and symbols in the manner of (1), (3), (4), (5), (6), (7), (8), and (9). We did so only for explanatory reasons. One simply computes the flows (x_{ij} and Y_i values), and the input-output coefficients (a_{ij} values). The latter then are arranged in tabular or matrix form, in the order presented in the left-hand bracketed member of (4). (The a_{ij} values along the diagonal, for $i = j$ are 1.) From these data we compute the inverse directly and obtain the interdependence coefficients. The interdependence coefficients are the "unknowns" of our analysis and are solved from the known quantities, the input-output coefficients.

A simple example of inverting a matrix and obtaining the input-output coefficients follows. Suppose that we have a two-sector economy where $X_1 = 40$, $X_2 = 80$, $x_{12} = 32$, $x_{21} = 20$, $Y_1 = 8$, and $Y_2 = 60$. By simple arithmetic $a_{11} = 1$, $a_{12} = -.4$, $a_{21} = -.5$, and $a_{22} = 1$. (The input-output coefficient of a "sector on itself," a where $i = j$, is always 1 and $a_{11} = a_{22} = 1$.) Thus, we have the input-output matrix of known values in (11) and wish to compute the unknowns of its inverse in (12). We now

$$(11)\qquad \begin{bmatrix} 1 & -.4 \\ -.5 & 1 \end{bmatrix} \qquad (12)\qquad \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}$$

$$(13)\qquad \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}\begin{bmatrix} 1 & -.4 \\ -.5 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

use the procedure of (13) and set the product of the inverse and the input-output matrices to equal the unit matrix in (13). The inverse of a given matrix is one which multiplied by the given matrix will give a unit matrix. By carrying out the multiplication as explained above (the rows of the c_{ij} matrix multiplied by the columns of the one with input-output coefficients), we obtain the four equations below. From these we compute the values of c_{11}, c_{21}, c_{12}, and c_{22} by simple elimination rules of algebra. Hence, we have $1.6\,c_{11} = 2$ and $c_{11} = 1.25$, etc. The same procedure is followed and all c_{ij} values are computed for the inverse matrix. Now using the procedure outlined for (8) and (9) we can predict the values of

$$\begin{aligned} c_{11} - .5c_{12} &= 1 \\ -.4c_{11} + c_{12} &= 0 \end{aligned} \qquad \begin{aligned} c_{21} - .5c_{22} &= 0 \\ -.4c_{21} + c_{22} &= 1 \end{aligned} \qquad \text{or} \qquad \begin{aligned} c_{11} &= 1.25 \\ c_{21} &= .625 \end{aligned} \qquad \begin{aligned} c_{12} &= .5 \\ c_{22} &= 1.25 \end{aligned}$$

X_1 and X_2, the net outputs, as in (14) below. The predicted values of X_1 and X_2, are identical with those specified at the outset. Thus the empirical part of the input-output

$$(14)\quad \begin{aligned} X_1 &= (1.25)(Y_1) + (.5)(Y_2) \quad \text{or} \quad X_1 = (1.25)(8) + (.5)(60) = 40 \\ X_2 &= (.625)(Y) + (1.25)(Y_2) \quad \text{or} \quad X_2 = (.625)(8) + (1.25)(60) = 80 \end{aligned}$$

analysis is complete and the computational work is not beyond the average clerk and arithmetician.

The only obstacle is in the amount of arithmetic involved. Although the "hand arithmetic" outlined above could handle larger problems, the task of eliminating variables to determine values of the c_{ij} coefficients would become long and tedious with more than 3 sectors. Hence, the least-cost method of operations is to follow the clerical routine through computation of the input-output table or matrix, then have the inverse matrix (i.e., calculation of the c_{ij} values) computed by a large-capacity calculator. Costs for this step are much less than the costs of clerical operations for most problems.

An Application to Agriculture

We now present the results of an input-output analysis, with emphasis on agriculture, based on 1949 data. The small model is inadequate for any detailed analysis of interindustry relationships. It should be looked upon as illustrative in nature.

The model includes 12 agricultural sectors; a crop or primary sector (sectors 1 to 6) and a livestock or secondary sector (sectors 7 to 12) for each of the six geographic regions shown in Table 1. It includes 8 industrial or nonfarm sectors, with aggregation to emphasize sectors that furnish inputs to or process products from agriculture.

The objectives of the study include describing relationships between

TABLE 1. COMPOSITION OF AGRICULTURAL REGIONS BY STATES

Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Me.	Ohio	Va.	N. D.	Mont.	Ariz.
N. H.	Ind.	W. Va.	S. D.	Ida.	Wash.
Vt.	Ill.	N. C.	Nebr.	Wyo.	Ore.
Mass.	Wis.	S. C.	Kan.	Colo.	Calif.
R. I.	Mich.	Ga.	Okla.	N. M.	
Conn.	Minn.	Fla.	Tex.	Utah	
N. Y.	Iowa	Tenn.		Nev.	
N. J.	Mo.	Ala.			
Pa.	Ky.	Miss.			
Del.		Ark.			
Md.		La.			

agriculture and certain components of the nonagricultural economy. Industry aggregation is based mostly on a detailed study of the United States economy made by the Bureau of Labor Statistics for 1947.[5] The industry sectors are:

Sector 13. Industries processing the products of primary agriculture, chiefly for food use, but including livestock feeds as by-products.
Sector 14. Industries processing the products of primary agriculture, chiefly for nonfood use.
Sector 15. Industries processing the food products of secondary agriculture.
Sector 16. Industries providing machinery, machine services, fuel and oil to all sectors of the economy.
Sector 17. Industries furnishing fertilizers, seeds and other supplies to agriculture, as well as many products to other sectors.
Sector 18. All other industries, including most services and transportation and merchandising.
Sector 19. Foreign trade.
Sector 20. Government.

Since agriculture is subdivided both geographically and by process, industry sectors might also be handled in the same way. A regional model developed by Isard included industrial product detail within regions.[6] He cautioned, however, that for such a model ". . . appropriate data are not currently available." Moses developed a similar model empirically, using relationships between national industries, and associated data on regional trade to estimate regional and interregional trade coefficients.[7] However, given the data problems of regional consideration of industry, and the objectives of this study, to stress agricultural production, it appeared less important to consider industries regionally even at a high level of aggregation.

Data for 1949 were of very uneven quality, with agriculture data generally more accessible than industry data. Even in agriculture, data shortages required either conceptual changes or estimates with low reliability. As in the 1947 Bureau of Labor Statistics study, "Judgment, informed guesses, and just plain hunches were required at many points to make the detailed allocations."[8] Nearly all agricultural data were available in their earliest form in *Agricultural Statistics,* with partial revision in later publications. Industry, trade, and government data came from many sources,

[5] See U. S. Dept. of Labor, *Industry Classification Manual for the 1947 Interindustry Relations Study,* Washington, 1953, (Mimeo.); and *Interindustry Flow of Goods and Services by Industry of Origin and Destination,* 1947. Washington, 1952.

[6] W. Isard, "Interregional and Regional Input-Output Analysis," *Review of Economics and Statistics,* Vol. 33, pp. 318-328.

[7] L. N. Moses, "Interregional Input-Output Analyses," *American Economic Review,* Vol. 45, pp. 803-832.

[8] National Bureau of Economic Research, *Input-Output Analysis; An Appraisal,* Princeton: Princeton University Press, 1955.

but the transactions table of the 1947 interindustry study was the basic reference for the latter sectors.[9] No attempt is made here to give a detailed description of the methods and sources used to estimate net outputs and their distribution. Such a description is available from another source.[10]

Interdependence Coefficients

The interdependence coefficients computed for the model outlined above are included in Table 2. These quantities are equivalent to the c_{ij} values shown in the matrix of (8) and the equations of (9). If put in matrix form and multiplied by the 1949 direct consumption of each of the 20 sectors, the product provides the output of the producing sectors. In the conventions of input-output literature, these coefficients might be interpreted as indicating the change in output of one producing sector associated with a *dollars worth* of change in final demand (direct consumption) for the output of any other sector. However, we prefer to interpret the quantities shown as the average amount of product in a particular sector associated, in 1949, with each *dollars worth* of product consumed directly from each other producing sectors. In this vein, we do not suppose that the "fixed mix" representing output of one sector will be projected into the future as national income increases. Neither do we suppose that the technical coefficients will remain constant as demand for the product of any one sector increases. Although the *fixed-mix* restriction is not a serious limitation when emphasis is on industry,[11] the problem is more difficult for agricultural sectors that specialize in products with definite interregional differences in income elasticities of demand.

In the simple model, intersector flows for agricultural regions were computed only for primary crops. Data on feeder stock were inadequate; all secondary livestock products were treated as if they went directly to sector 15. Although there were blanks in the table of input-output coefficients, there are none in the table of interdependence coefficients, however, because interrelationships are expressed both directly to a sector, and indirectly back through other sector.

Given the model employed, the important elements affecting farm sectors are magnitudes of final demand for the products of industries processing the products of agricultural sectors. The figures presented represent interindustry relationships for a given point in time, namely,

[9] U. S. Department of Labor, *Interindustry Flow of Goods and Services by Industry of Origin and Destination*, Washington, 1952.

[10] John S. Schnittker and Earl O. Heady, *Application of Input-Output Analysis to a Regional Model Emphasizing Agriculture*, Iowa Agr. Exp. Sta. Report (unpublished).

[11] J. M. Ryan, "The Leontief System," *Southern Economic Journal*, Vol. 19, pp. 481-489.

TABLE 2. INTERDEPENDENCE COEFFICIENTS BETWEEN THE FINAL BILL OF GOODS AND NET OUTPUTS FOR 1949

Sector number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Primary (crop) agriculture sectors						Secondary (livestock) agriculture sectors						Industry sectors							
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Crop-food products	Nonfood crop products	Livestock products	Machinery and fuel	Miscellaneous supplies	All other products	Foreign trade	Government
1	1.0239	0.0016	0.0017	0.0012	0.0013	0.0015	0.3013	0.0025	0.0056	0.0026	0.0021	0.0047	0.0211	0.0073	0.0318	0.0014	0.0083	0.0018	0.0059	0.0029
2	0.0099	1.0365	0.0068	0.0055	0.0067	0.0068	0.0336	0.4014	0.0174	0.0100	0.0118	0.0232	0.0675	0.0681	0.1366	0.0081	0.0230	0.0106	0.0404	0.0158
3	0.0076	0.0083	1.0202	0.0051	0.0060	0.0059	0.0184	0.0085	0.4239	0.0089	0.0079	0.0146	0.0581	0.1076	0.0399	0.0087	0.0133	0.0103	0.0726	0.0162
4	0.0079	0.0064	0.0058	1.0321	0.0070	0.0064	0.0184	0.0086	0.0139	0.4846	0.0203	0.0258	0.0582	0.0573	0.0666	0.0075	0.0165	0.0092	0.0463	0.0214
5	0.0022	0.0016	0.0016	0.0012	1.0376	0.0015	0.0061	0.0025	0.0044	0.0027	0.0413	0.0048	0.0207	0.0072	0.0201	0.0015	0.0063	0.0019	0.0064	0.0053
6	0.0041	0.0028	0.0028	0.0022	0.0025	1.0128	0.0176	0.0064	0.0125	0.0070	0.0056	0.3165	9.0655	0.0204	0.0233	0.0028	0.0085	0.0036	0.0171	0.0067
7	0.0760	0.0012	0.0011	0.0010	0.0011	0.0011	1.0240	0.0013	0.0020	0.0013	0.0012	0.0020	0.0066	0.0050	0.1013	0.0014	0.0025	0.0022	0.0053	0.0028
8	0.0046	0.0814	0.0035	0.0033	0.0039	0.0037	0.0090	1.0338	0.0064	0.0045	0.0044	0.0070	0.0215	0.0204	0.3307	0.0050	0.0078	0.0075	0.0190	0.0096
9	0.0012	0.0010	0.0366	0.0008	0.0010	0.0009	0.0021	0.0011	1.0161	0.0012	0.0011	0.0017	0.0058	0.0072	0.0755	0.0013	0.0019	0.0019	0.0062	0.0025
10	0.0019	0.0017	0.0015	0.0598	0.0017	0.0016	0.0035	0.0019	0.0028	1.0290	0.0025	0.0035	0.0096	0.0016	0.1229	0.0022	0.0033	0.0031	0.0089	0.0044
11	0.0007	0.0006	0.0005	0.0005	0.0822	0.0006	0.0013	0.0007	0.0010	0.0007	1.0368	0.0011	0.0038	0.0051	0.0398	0.0008	0.0013	0.0011	0.0027	0.0015
12	0.0008	0.0007	0.0006	0.0006	0.0007	0.0346	0.0017	0.0008	0.0013	0.0009	0.0008	1.0115	0.0049	0.0039	0.0529	0.0080	0.0013	0.0012	0.0033	0.0016
13	0.0309	0.0161	0.0178	0.0140	0.0149	0.0158	0.2557	0.0823	0.1770	0.0922	0.0682	0.1954	1.0195	0.0342	0.1028	0.0131	0.0201	0.0206	0.0612	0.0222
14	0.0267	0.0249	0.0233	0.0210	0.0248	0.0228	0.0386	0.0245	0.0325	0.0249	0.0242	0.0322	0.0810	1.0243	0.0261	0.0463	0.0372	0.0492	0.1194	0.0312
15	0.0121	0.0108	0.0095	0.0089	0.0106	0.0099	0.0202	0.0114	0.0161	0.0018	0.0111	0.0165	0.0517	0.0441	1.0120	0.0137	0.0190	0.0210	0.0500	0.0261
16	0.1640	0.1696	0.1357	0.1463	0.1845	0.1608	0.1127	0.1104	0.1094	0.1127	0.1258	0.1076	0.0914	0.0725	0.0891	1.0419	0.0623	0.0668	0.2919	0.0662
17	0.1448	0.0866	0.1056	0.0475	0.0521	0.0617	0.0615	0.0437	0.0584	0.0333	0.0338	0.0413	0.0443	0.0431	0.0364	0.0326	1.0178	0.0242	0.0970	0.0210
18	0.4674	0.4659	0.4076	0.3991	0.4768	0.4243	0.4624	0.3928	0.4310	0.3956	0.4093	0.4138	0.4487	0.4056	0.3677	0.6481	0.5457	1.1565	1.0222	0.4824
19	0.0281	0.0252	0.0213	0.0206	0.0248	0.0234	0.0445	0.0256	0.0352	0.0263	0.0251	0.0364	0.1123	0.0698	0.0341	0.0332	0.0423	0.0425	1.0518	0.0886
20	0.1653	0.1554	0.1140	0.1247	0.1540	0.1457	0.1351	0.1143	0.1132	0.1131	0.1211	0.1195	0.1426	0.1631	0.1068	0.1652	0.1647	0.1875	0.2364	1.0881

1949. They represent a *fixed mix* in the product reflected for each producing sector; or between producing sectors for any particular Y_i quantity or change. However, these relationships express some interesting *conditions* for agriculture in 1949. The coefficients in the table show the amount of output in the row sector per dollar's worth of final demand for the products of the colum sector. (We can think of the table as the matrix of interdependence coefficients such as the matrix of c_{ij}'s in (8); there, the column headings indicate the Y_i elements in the Y matrix and the row-stub headings for represent the X_i values of the X matrix.) Thus a dollar's worth of final demand for crop-food products, sector 13, is associated with an output of only \$.0211 in sector 1 (the Northeast), and \$.0655 in sector 6 (the Pacific Coast), where a large proportion of fruits and vegetables move into sector 13 processing, and then to final demand. The interdependence coefficient of sector 13 with sector 5 (crop production in the Mountain states) is only \$.0207. The bulk of crop production there consists of forage crops, which move to livestock in the same region.

The sum of the first six rows in column 13 is only .291. This magnitude points up, in numerical terms, the existing situation in respect to the farmer's share of the consumer's dollar spent for crop-food products. Each dollar of final demand or household consumption of products in sector 13 requires only a 29-cent output by all agricultural crop sectors. The large interdependence coefficient, 45 cents (column 13, row 18), indicates that each dollar's worth of consumption of products in sector 13 is associated with a large output by sector 18. Sector 18 includes mainly transportation and merchandising services.

A dollar of final demand for sector 15 or livestock products is associated with a *total mix value* of 72 cents (i.e., the sum of rows 7-12 in column 15), for the six secondary agricultural sectors. The fact that this figure is much greater for livestock than for crops expresses the fact that a much larger proportion of the consumer's dollar reaches the farmer for livestock products. More than 33 cents of the 72-cent total is drawn from the Cornbelt where the main farm product is livestock and represents the major part of the pork, beef and milk consumed by the nation. The second largest interdependence coefficient is for sector 10 which includes the western portion of the hog-raising and beef-feeding area; and which provides a considerable amount of beef processed directly from the range. Although livestock is the important product of sector 11, most of this product is range beef and sheep, which moves to the feed lots of sectors 8 and 10, rather than directly to processing in sector 15.

The magnitude of the interdependence coefficients of sector 15 on regional crop-producing sectors also is of interest. The largest coefficient again is for the Cornbelt (sector 8). In 1949, a dollar's worth of final

demand for the product of livestock processing in sector 15 was associated with a 14-cent output of crops insector 8. This is true because most of the crop product in the Cornbelt (sector 2) moves to livestock in the same region (sector 8), and then into the livestock-processing industry (sector 15). A dollar's worth of final demand for products in sector 15 (livestock at retail) required a crop output in the Cornbelt greater than the livestock output in any other region.

Based on the model, final demand for the product of industrial sector 18 had little relationship to the output of agricultural sectors. The coefficients range from .0011 for secondary output in the Intermountain states (sector 11) to .0160 for primary output in the Cornbelt. In contrast, however, final demand for products of agricultural sectors required a much greater output from sector 18. These quantities (row 18, columns 1 to 12) range from .3928 in the case of secondary products in the Cornbelt to .4768 in the case of primary products in the Intermountain states. Similarly, sector 16 (machinery and fuel) final demand bears only a trivial relationship to output of agricultural sectors (column 16, rows 1 to 12). However, the opposite is not true. One dollar of final demand for crop or primary agricultural products in sector 5 (the Intermountain states) was associated with an 18-cent output in the machinery and fuel sector. The figure was 14 cents for the Southeast (sector 3), where more of the work is done by man and horse power, and machine inputs per dollar of crop output are generally lower than for other regions (row 18, columns 1 to 6).

Limitations

Other interesting notes relating to magnitudes of interdependence coefficients could be mentioned. However. this detail will not be included in order that a summary of limitations of the model can be included in this paper. Input-output analysis is, in a sense, descriptive. Although the particular model used permits description of interrelationships among sectors at a point in time, it is less appropriate as a tool for exlaining these relationships, or in predicting the producing structures under long-term economic growth. It has *projective* value mainly for small changes anticipated in the immediate future. This last statement holds true because of the restrictions on the *fixed input mix* forced into the system of equations by the linear coefficients. If total demand (the final bill of goods) were to increase by large proportions, it is not likely (a) that the *mix* of agricultural products forthcoming within regions, (b) that the relative mix between agricultural regions, or (c) that the relative mix between agriculture and industry, would remain in the constant proportions reflected by the input and interdependence coefficients. By accounting for change in coefficients, some useful projections might be possible, however.

As a "diagnostic tool," input-output analysis is generally as useful, and perhaps more useful for particular purposes, than the great body of arithmetic, descriptive analyses used so often in statements on agricultural policy or about changes in the agricultural economy. It has many of the same limitations as these types of analyses, but it is relatively more formal and precise. In a statistical sense, there are no degrees of freedom since one observation is used to predict each parameter and the model has no stochastic properties. When computed from value quantities and used to predict physical quantities, the coefficients give rise to problems in index numbers. Judgment in correct aggregation procedure is always difficult. However, these assumptions and restrictions are no more serious than those inherent in arithmetic, descriptive analyses of agriculture based on agricultural census data.

LABOR UTILIZATION IN INDIAN FARMING*

C. P. SHASTRI[1]
Government Agricultural College, Kanpur, U. P., India

Introduction

ONE distinguishing feature of the agricultural economy of India, compared with that of the U.S.A. or the U.K., is that farms have not emerged as commercialized enterprises and are not much affected by the modern industrial system. The patterns of agricultural development in the U.S.A. and the U.K. have followed the demand of the world market for agricultural products and have consequently been organized for the purpose of meeting this demand. Farming for these countries is therefore essentially a business proposition, i.e., a business venture to be started or abandoned according to the propects of profits or losses, without any special bonds grown out of tradition as to the size and constitution of holdings inherited from the past or as to the age-old methods of cultivation.

India and other underdeveloped countries, where the system of subsistence farming is predominant, land utilization has not reached a point of scientific adjustment. The structural adjustment in agriculture is one of the major factors preventing maximum utilization of land. Indian agriculture is still a way of living, the farm being a family home more than a business unit.

The cultivated land in India is seldom classified or spoken of as farms. The main reason for this lies in the absence of many of the characteristics usually associated with typical farms in Western countries. The agricultural units are not compact blocks fenced on all sides and are not operated with systematic attention to costs and profits, systems of crop rotation, and fertility of lands.

Holdings vs. Farms. As a unit of study two different terms have been used: (1) holding and (2) farm. The holding differs from the farm, apart from size, in that the operator participates in farm work as well as makes most of the managerial decisions and his function as employer of labor is minor relative to his other functions. In case of farms the entrepreneur

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simply works as a manager whose function is to employ labor and to supervise the farm work. On some farms the manager is also employed, and the work of the entrepreneur is limited only to occasional supervision of the farm.

Labor plays an important role in Indian farming, and there are many problems associated with it. On one hand the Indian cultivator has a surplus of labor for which he requires subsidiary occupations closely associated with his main occupation so that the surplus may be utilized gainfully. On the other hand, despite a considerable amount of surplus overall labor, he is compelled to engage casual labor during the peak seasons of farming.

Purpose of This Paper. In the present paper an attempt has been made to throw light on some systems of employment of labor, the amount of wages paid to permanent and casual labor, the intensity of labor use per acre, labor productivity, the extent of the unutilized labor force, and the extent of casual labor employed in farming. It is expected that the data presented will be helpful to policymakers in suggesting ways and means of utilizing the full labor force available with the cultivators, by introducing subsidiary industries adapted to the region, and by improving cultivators' cropping programs, rotations followed, and their efficiency in the use of labor.

Source of Data. The basic data for the study were obtained from 401 randomly selected holdings of different sizes in 16 villages in the upper Ganges Doab[2] in the districts of Meerut and Muzaffarnagar, Utter Pradesh, India, in the year 1950-51. In addition, 19 private farms (13 non-mechanized and 6 partially mechanized-tractor cultivated) were included to give a comparative view of farm management problems on the holdings and well-organized farms. For the purpose of showing monthly labor utilization, three-year average data for Government Farm, Meerut[3] (non-mechanized), for 1948-49 to 1950-51 have been used.

The area represents one of the best agricultural tracts in Uttar Pradesh and also in India. The region is populated by one of the most industrious and skilled groups of farmers of the country. In fact, it owes its agricultural prosperity more to the hard labor and farming skill of the farmers than to its natural resources. The fields are well levelled and impress the visitor with the devotion with which the farmer cultivates them. The soil in these districts is mostly light loam. The normal rainfall is about 29 inches, and approximately two thirds of the cultivated area is irrigated, largely by canals. Only about one third of the total cultivatad area is

[2] The upper region between the Jumna and Ganges Rivers is known as the upper Ganges Doab.

[3] This farm, like most government farms in India, is used to demonstrate improved farming methods and is expected to operate at a profit.

double cropped. The average size of holding was about 12 acres. As a result of land-reform measures adopted in the state, the land was, with very few exceptions, owned by the operator. The agricultural population accounted for 54 percent of the total in the districts.

The cultivated area constituted 80 percent of the total area and the uncultivated waste about 9 percent, while the remaining 11 percent was under water and in cities, roads, and buildings. The area under forest was negligible, being only 0.01 percent of the total. Wheat, sugarcane, gram (a pulse), corn, and rice are the major crops grown in the area. In addition an appreciable area is under fodder crops (largely sorghum) which occupy about 24 and 18 percent of the cultivated and gross-cropped areas respectively. Sugarcane is the most important cash crop, occupying 21 percent of the total cultivated area. Ratoon[4] accounted for about 30 percent of the total area under sugarcane. The type of farming may be described as specialized sugarcane-grain.

The Basis of Labor Employment. In addition to family workers, farm labor is engaged on either a daily or a yearly basis. During winter, however, labor is engaged for three to four months; and during the threshing of *rabi*[5] crops laborers are kept for a month or so. On certain occasions some work on a contract basis is also done, especially during harvesting and threshing periods and for weeding purposes.

The System of Payment of Wages. Daily labor. The wages paid to daily labor varied from Rs.1/4/–[6] to Rs.1/8–. The most common rate of daily wages was Rs.1/8/–. In addition to the cash wages two *breads*[7] and a small quantity of *gur* (raw sugar), the money value of which came to about –/3/– to –/4/– annas, were also given to daily laborers.

The system of wages in kind was losing ground. These wages consisted of about 3½ *seers*[8] of grain in addition to two *breads* and a small quantity of *gur*.

Permanent labor. The system of payment to permanent laborers differed from village to village and even in the same village from culti-

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[4] Ratoon is the sugarcane crop raised from new shoots that spring up from the roots after a first crop is harvested.

[5] *Rabi* is the low-rainfall winter-crop season extending from November to April. This is the season during which wheat, barley, oats, peas, mustard, and linseed are grown. The other principal growing season, extending from July to October, is the season of the monsoon rains and is called *Kharif*. Sorghum, corn, and rice are principal crops of this season. Sugarcane grows throughout the year.

[6] Rs.1/4/– may be read as one rupee and four annas. One rupee = $0.211; one anna = 1/16th rupee; one U. S. dollar = 4.77 rupees. Since this study was done a new currency law has taken effect dividing the rupee into 100 naye paise or "new pice."

[7] Each *bread* is made up of flour—either wheat, wheat and gram, or corn—weighing about two *chatanks* (one *chatank* = 1/16 *seer*) or about one-fourth of a pound.

[8] One *seer* = 1/40th *maud* or 2.057 pounds.

vator to cultivator. The *Sajhi* systems[9] was still practised in certain villages in which the laborer was entitled to one sixth to one fourth of the total produce excluding green and dry fodder. In certain villages a fixed quantity of the grain, about 25 *maunds,*[10] was paid to each permanent laborer in lieu of wages; and in addition he was given two *breads* and a small quantity of *gur* each day plus one *maund* of *gur* per year and one blanket or cotton sheet for use during winter only. More than half of the fixed quantity of grain was given to the laborer in advance.

The cash wage of permanent labor was Rs.30/— to Rs.35/— per month. More than half of the annual amount of the monthly wages was taken in advance, but no interest was charged on this advance. The monthly farm servants also got *breads* and *gur* daily, one *maund* of *gur* each year, and a blanket or cotton sheet. During harvesting they got, in lieu of regular monthly wages, the same share of produce as was paid to the daily laborers or, in addition to regular monthly wages, two *maunds* of grain. They were not given any leave with pay.

In a few cases labor was paid Rs.10/— to Rs.15/— per month and given the use of about two fifths of an acre of land known as *bhonda*[11] for sowing wheat or other crops, fodder for one cow or buffalo maintained by him for milk, and all other perquisites given to the monthly labor as mentioned above.

The harvesting of *rabi* crops was done on a share or contract basis. The laborers got about one twenty-fifth of the crop harvested by them. Similarly, during the harvesting of rice and corn (*kharif* season crops) they got two *seers* per *maund* (one twentieth) of the produce harvested and threshed by them.

Days of Labor Used per Acre

On Holdings. A definite relationship existed between the size of holding and total labor utilized per acre (Table 1). An increase in the size of holding was followed by a decline in labor used per acre. The downward trend was very sharp up to holdings of 5 to 7.49 acres. Further variations, though distinct, were not so great. Labor used vared from 198 days per acre on holdings in the size group below 2.49 acres to 72 days per acre on holdings of 20 acres or more and averaged 83 days per acre for all holdings.

A higher intensity of cropping and a slightly higher percentage of sugarcane to total cropped area accounted for some of the high labor input on

[9] *Sajhi* means sharer, the term used for agricultural laborers receiving payment in the form of a share of produce.

[10] A *maund* is a measure of weight equal to 82.28 pounds.

[11] The term *bhonda* is used for land, the produce of which is given to agricultural laborers in lieu of wages.

TABLE 1. LABOR USED PER ACRE, PERCENT OF PERMANENT LABOR UNUSED, AND PERCENT OF TOTAL LABOR SUPPLIED BY CASUAL WORKERS, BY SIZE OF HOLDING AND CLASS OF FARM, 1950–51

Group of Farms	Number of farms	Average size (acres)	Days of labor used per acre	Percentage of permanent labor supply unused	Percentage of total labor supplied by casual workers
Small holdings (by size, acres)	401	12.85	83	20	25
2.49 or less	14	1.88	198	51	12
2.5 – 4.99	57	3.78	123	39	18
5.0 – 7.49	58	6.32	101	34	21
7.5 – 9.99	56	8.77	91	28	24
10.0 –14.99	87	11.96	84	19	24
15.0 –19.99	61	17.14	81	14	25
20.0 or more	68	26.92	72	6	29
Other farms	19	89.18	52	20	34
A. Non-mechanized	13	53.71	64	9	31
B. Partially mechanized	6	166.01	25	34	39
A. Irrigatd by canals or tubewells	12	107.86	34	27	38
B. Irrigated partly by canals or tubewells and partly by *desi*[a] wells	7	57.15	65	4	28
A. Wholly irrigated	10	57.84	67	8	32
B. Partially irrigated	9	123.99	28	31	36

[a] The *desi* or local type of well is a shallow well from which water is commonly drawn by a "leather bucket" or a Persian wheel, both of which employ bullock power. Tubewells, on the other hand, are commonly pumped by electric engines.

small holdings (Table 2), but these do not justify fully the higher utilization of labor on these holdings. Labor utilization per acre of crops grown remained considerably higher on the smaller holdings, being 100 days per acre, than on holdings in the size group above 20 acres where it was only 56 days per acre. The return per man-work-day was Rs.4.74 on the holdings of 2.49 acres or less while on holdings of 20 acres or more it rose to Rs.6.65, the average being Rs.5.94 per man-work-day for all holdings. The extent to which a transfer of some of the large quantity of labor now actually used in agriculture to nonagricultural occupations, or from farms of one size to those of another, would be profitable depends on the shape of the *marginal* productivity curves for labor in alternative uses. Detailed studies of these curves have yet to be carried out.

On Farms by Size and Mechanization. Wide variations, ranging from 27 to 140 days, existed in labor used per acre on different bullock-operated

or nonmechanized farms. Labor use depended mostly on type of soil, nature of crops grown, and irrigation facilities available. It was at a minimum on a farm where no adequate irrigation facilities were available and the farm was newly reclaimed so that a portion of the land was unsown during the year. On an average it came to 64 days per acre (Table 1).

The labor used per acre was 30 percent higher on holdings than on nonmechanized farms. The following facts may be cited as causes of higher labor utilization on holdings. (1) The intensity of cropping was

TABLE 2. INTENSITY OF CROPPING, PERCENT OF AREA UNDER SUGARCANE, AND PERCENT OF SUGARCANE WHICH IS RATOON CROP, BY SIZE OF HOLDINGS AND CLASS OF FARM, 1950–51

Group of farms	Number of farms	Average size (acres)	Intensity of cropping[a] (percent)	Percent of area under sugarcane	Percent of sugarcane which is ratoon crop
Small holdings (By size, acres)	401	12.85	135	21	30
2.49 or less	14	1·88	166	25	42
2.5 – 4.99	57	3.78	148	24	39
5.0 – 7.49	58	6.32	146	22	34
7.5 – 9.99	56	8.77	142	22	20
10.0 –14.99	87	11.96	135	20	28
15.0 –19.99	61	17.14	134	22	29
20.0 or more	68	26.92	130	21	30
Other farms	19	89.18	121	30	45
A. Non-mechanized	13	53.71	130	23	48
B. Partially mechanized	6	166.01	116	34	43
A. Irrigated by canals or tubewells	12	107.86	119	32	44
B. Irrigated partly by canals or tubewells and partly by *desi*[b] wells	7	57.15	129	22	48
A. Wholly irrigated	10	57.84	130	23	49
B. Partially irrigated	9	123.99	116	34	43

[a] This is the ratio, expressed as a percent, of the area of crops grown (the gross cropped area) to the land area planted to crops one or more times during the year (the cultivated area).
[b] See footnote[a] to Table 1.

greater on holdings than on farms—135 as against 121 percent (Table 2). (2) Labor-saving implements, such as cultivators, hoes, and heavy plows, were freely used on farms, but were not within the means of small holders. (3) Farms generally supplied sugarcane directly to the factory, mostly by trucks, or used power-driven machinery, while such facilities were not available to farmers with small holdings. (4) Planted sugarcane being more profitable than the ratoon crop, operators of small holdings

were less likely to leave ratoon than were operators of farms (Table 2). (5) Some labor in excess of economic requirements was used in seed-bed preparation and intercultural operations on holdings because the small cultivator, being unemployed elsewhere, turned often to his field, as is evident from Table 1. Even so, the percentage of the permanent labor supply unused on holdings was more than double that on nonmechanized farms. (6) The cultivators' holdings were widely scattered causing great loss of time in going and coming to their fields.

On partially mechanized farms (those using tractors) the utilization of labor per acre was only 39 percent as high as on nonmechanzed farms. On an average, labor used amounted to 25 days per acre (Table 1) and ranged between 18 and 45 days.

By source of Irrigation. Labor use was higher on farms irrigated partially from *desi*[12] wells than on farms receiving irrigation water from canals and tubewells only. On an average it amounted to 65 and 34 days per acre respectively.

By Extent of Irrigation. The labor utilization was higher on farms having all the area under irrigation than on partially irrigated farms—67 and 28 days per acre respectively.

Labor utilization may be summarized as follows: (1) The smaller the size of farm or holding the greater the intensity of labor use. (2) The labor utilization per acre was more than twice as high on nonmechanized farms than on partially mechanized ones. (3) The farms irrigated partially by *desi* wells used nearly twice as much labor per acre as farms irrigated by canals and tubewells only. (4) The wholly irrigated farms used more than twice as much labor per acre than partially irrigated farms.

Percentage of Permanent Labor Supply Unused

In order to determine the percentage of the permanent labor supply which was unused, the total available supply of permanent labor was calculated by multiplying the number of working days in the year times the number of working hours per day times the total number of permanent laborers including family workers. A working year was taken as 312 days; and although the hours worked during the day were commonly spread over a period of 10 to 12 hours, depending upon the season, the actual working hours amounted to approximately eight hours, so that a working day was taken as eight hours. Women and children were converted to adult-male equivalents, three women being equal to two adult males and two children equal to one adult male.

On Holdings. Size of holdings and the percentage of unused labor were distinctly related (Table 1). With an increase in the size of holdings the

[12] See footnote * to Table 1.

percentage of unused labor decreased. It was at a maximum on the holdings of 2.49 acres or less, while the holdings above 20 acres in size were responsible for the minimum percentage of unused labor. The range of variation, as shown, was between 6 and 61 percent. The variation depended on the efficiency of workers, size of holdings, and intensity of cropping. On an average 20 percent of all permanent labor was unused for all holdings. On the holdings below ten acres about one third of the permanent labor was recorded as unusued. Hence it is clear that the labor on these holdings definitely remains underemployed, at least in a physical sense.

The percentage of permanent labor unused was more than twice as high on holdings than on nonmechanized farms, which may be attributed largely to the smaller size of holdings than of nonmechanized farms–13 and 54 acres respectively.

On Farms by Size and Mechanization. Detailed examination of the data revealed that on only four nonmechanized farms could the labor be utilized fully, while in the case of other farms there was a wide variation in the percentage of unused labor, depending on the efficiency of managers. To some extent labor unused corresponded inversely to the intensity of cropping. The percentage of unused labor varied from 3 to 36 percent, the average being 9 percent for all nonmechanized farms.

A comparison between nonmechanized farms and those that were partially mechanized revealed that the percent of unused labor was much higher in the case of the latter where it ranged between 8 and 51 percent and averaged 34 percent. Tractor cultivation reduced to a great extent the work available even for permanently employed laborers.

By Source of Irrigation. The farms receiving their irrigation partly from *desi* wells provided more employment to the farm laborers than the farms irrigated by canals and tubewells only. The percentage of the permanent labor supply unused averaged 4 and 27 percent respectively on the two groups of farms.

By Extent of Irrigation. The wholly irrigated farms accounted for a very high percentage of labor utilization in relation to permanent labor available. On an average the percentage of permanent labor unused came to 8 and 31 percent for wholly irrigated and partially irrigated farms respectively.

Briefly, the above discussions may be summarized as follows: (1) An increase in the size of holdings was followed by a decrease in the percentage of permanent labor unused. (2) The percentage of labor supply unused was lower on bullock-operated holdings and farms than on partially mechanized farms. (3) The farms receiving their irrigation partly from *desi* wells provided more employment to the farm labor than the

farms irrigated by canals and tubewells only. (4) Wholly irrigated farms had a lower percentage of labor supply unused than partially irrigated farms.

Percentage of Total Labor Supplied by Casual Workers

On Holdings. Despite widespread underemployment of the total supply of permanent labor on holdings (Table 1), casual labor was employed on different occasions due to the peculiar nature of agricultural operations, especially during harvesting, transplanting, and crushing of sugarcane. The percentage of temporary or casual labor to total labor, even on the smallest holdings, i.e., below 2.49 acres, was 12 percent on an average. Further, an increase in the size of holdings was followed by an increase in the percentage of casual labor. The variation was between 12 and 29 percent, and on the average it came to 25 percent for all holdings.

On Farms by Size and Mechanization. Nonmechanized farms employed casual labor to the extent of 13 to 46 percent of the total labor employed during the year. On an average 31 percent of all labor was supplied by casual workers on these farms. Partially mechanized farms used a higher percentage of casual labor than nonmechanized farms. This appeared to be due to the fact that less casual labor can be used efficiently and economically on these farms. Casual labor varied from 16 to 55 percent, the maximum percentage occurring on a farm having the largest area, and averaged 39 percent.

By Source of Irrigation. Farms obtaining water for irrigation from canals and tubewells only, despite their having 27 percent of their permanent labor supply unused, engaged casual labor to the extent of 38 percent of their total labor used. This was 10 percent higher than the farms irrigated partially by canals or tubewells and partially by *desi* wells where the percent of permanent labor unused was only 4 percent. Irrigation from *desi* wells may be used to supplement canal irrigation without in many instances increasing the casual labor requirement. It may serve to ensure more complete utilization of existing permanent labor supplies.

By Extent of Irrigation. The extent of irrigation does not seem to have any marked effect on the percentage of total labor supplied by casual labor.

The results regarding use of casual labor may be summarized as follows: (1) The larger the farm or holding, the higher the percentage of total labor supplied by casual labor. (2) Partially mechanized farms had a higher percentage of casual to total labor employed than the nonmechanized farms. (3) The farms irrigated by canals or tubewells had a higher percentage of casual labor than farms irrigated partly by canals or tubewells and partly by *desi* wells. (4) The wholly irrigated farms had a slightly lower percentage of casual labor than partially irrigated farms.

Montly Distribution of Labor on Government Farm, Meerut

Permanent Labor. At Government Farm, Meerut, there was, on the average from 1948-49 to 1950-51, a 33-percent increase in permanent labor utilization from the low month of April to the high month of January (Table 3). The lowest percentage utilization in April was due to the

TABLE 3. MONTHLY DISTRIBUTION OF PERMANENT, CASUAL, AND TOTAL LABOR USED, GOVERNMENT FARM, MEERUT, 1948–49 TO 1950–51 AVERAGE

Month	Permanent labor		Casual labor		Total labor	
	Hours per acre	Percent of total	Hours per acre	Percent of total	Hours per acre	Percent of total
June	31	8.22	36	7.23	67	7.68
July	31	8.22	32	6.43	63	7.22
August	30	7.96	42	8.45	72	8.26
September	34	9.03	42	8.45	76	8.72
October	33	8.75	41	8.25	74	8.49
November	32	8.49	44	8.84	76	8.72
December	31	8.22	38	7.64	69	7.91
January	36	9.55	37	7.43	73	8.37
February	31	8.22	32	6.43	63	7.22
March	30	7.96	38	7.64	68	7.80
April	27	7.16	57	11.45	84	9.63
May	31	8.22	56	11.26	87	9.98
Total	377	100.00	495	100.00	872	100.00

fact that the month being a busy one for harvesting the *rabi* crops, the permanent laborers were given the wages for harvesting the crops at the rates of daily laborers employed for harvesting.[13] Thus their time and wages were allocated to the casual labor account. This brought the percent utilization of permanent labor to the monthly minimum for the year. If this month were excluded, the difference between low and high use of permanent labor came to only 20 percent.

Casual Labor. There was a 78 percent increase in casual labor utilization from the low months of February and July to the high months of April and May. April and May required considerable additional labor, besides the regular supply of permanently employed labor, to harvest and thresh *rabi* crops. A considerable amount of casual labor was used throughout the year but especially also from August to November during which time the preparation for sowing and sowing of *rabi* crops and harvesting of *kharif* crops were accomplished.

Total Labor. Averaging the figures for three years revealed that the month of May accounted for the highest total labor utilization, followed

[13] See the comments on the system of payment of wages above.

closely by April. September, October, and November were other months responsible for high labor utilization. During the months of July and February utilization was lowest. It was apparent that the maximum labor use was required during sowing, harvesting, and threshing periods of crops.

The percentage of total annual labor requirements by months varied between 7.22 and 9.98 percent, which means that there was a 38-percent increase from the low month to the high month. If the permanent labor supply could have been kept in line with the low-month requirement, some casual labor would have been required in ten out of twelve months; and in some months there would have been needed nearly 40 percent as much casual labor as permanent labor. On the other hand with a total labor supply adequate to meet peak labor requirements under the present farm organization, some labor could have been spared for nonfarm work during eleven out of twelve months; and nearly 20 percent of the total labor supply would have been available for nonfarm work. Major agricultural programs of government, such as those affecting the overall availability and the source of irrigation water, as well as intrafarm organizational and technical adjustments, can be expected to affect significantly the pattern of labor use in agriculture in India. Comprehensive and up-to-date knowledge of this pattern is essential to the effective planning for use of surplus labor.

CONSUMER SURVEY VERSUS STORE DATA FOR DETERMINING EGG CONSUMPTION*

H. Bruce Bylund and Ralph L. Baker
The Pennsylvania State University

NUTRITIONAL research has shown that an inadequate breakfast results in both physical and mental slowdown during the late morning.[1] With these results in mind, a study was designed to measure the effects on egg consumption of a program to improve the nutritional quality of breakfasts. This was a month-long program conducted in Waynesboro, Pennsylvania, a community of about 10,000 population, during January 1955.

The program was a joint research-extension undertaking. It was developed by calling together nutritionists, rural sociologists, agricultural economists, poultry specialists, a specialist in consumer information, a statistician, and certain administrative personnel. The program attempted to apply relationships obtained in an earlier consumer study.[2] Some of the basic findings taken into account included the following:

1. The number of eggs eaten was related to the homemaker's idea of effects of eggs on health.
2. Eggs were used primarily as a breakfast food.
3. Egg consumption was higher if all members of the family ate breakfast together.
4. Husbands ate the most eggs, children were next, and wives ate the fewest eggs.
5. Homemakers who believed that eggs could be prepared with little effort and in a short time served more eggs than those who believed eggs were inconvenient to prepare.

The Program

To emphasize the importance of a good breakfast to school children, a set of three albino rats was placed in each of the eleven elementary and junior high schools in the test area. Each of the three animals was fed a different diet which represented three kinds of breakfasts. The animals

* Authorized as Journal Series Paper 2122, Pennsylvania Agricultural Experiment Station.

[1] W. W. Tuttle, K. Daum, L. Meyers and C. Marten, "Effect of Omitting Breakfast on the Physiologic Response of Men," *Journal of American Dietetic Association*, Vol. 26, No. 5, May, 1950. W. W. Tuttle, K. Daum, R. Larsen, J. Salzano and L. Roloff, "Effects on School Boys of Omitting Breakfast," *Journal of the American Dietetic Association*, Vol. 30, No. 7, July, 1954.

[2] H. Bruce Bylund, "Selected Social and Psychological Factors Associated with Levels of Egg Consumption," Unpublished Ph.D. Dissertation, The Pennsylvania State University Library, 1954.

were weighed each week and the weight recorded by one of the students. Reasons for the differences in growth were discussed during the weekly weighing period by University nutritionists.

Four special meetings in the home-service room of the local power company emphasized better nutrition. In addition, eleven programs dealing with eggs were given by home economists at regular group meetings of local organizations.

Good press and radio coverage was given to the school demonstrations as well as in other parts of the program. In addition to regular news broadcasts concerning the program, there were seven 15-minute radio broadcasts concerning the overall program. Announcements were made of the meetings by the local radio stations, and 150 20-second spot announcements on "why eat breakfast" were made on local radio stations.

Extension leaflets dealing with ways of using eggs, and on the importance of breakfast were prepared by nutritionists and distributed during the program period. Point-of-sale posters were used in retail food stores.[3]

Egg consumption data were obtained from consumers and egg sales data were obtained from retail stores to assess the effects of the program on egg consumption. It was expected that the two methods would yield similar results. This was not the case. The consumer survey indicated an increase in egg consumption of 36 per cent from before the program to immediately afterward while the store sales of eggs showed a decline of 12 percent. Which of these results was more nearly a true picture of egg consumption in the community?

For the consumer survey, a representative sample of households containing two or more persons was contacted prior to the campaign (first week of January 1955) and again immediately afterwards (first week of February 1955). After family size and composition had been obtained, each homemaker was asked for a detailed record of what had been eaten by the family for the past 6 meals. (It had been found by a previous survey that any two consecutive days were not significantly different from a seven-day period in the quantity of eggs used daily in the household.) The interviewer mentioned that since eggs and milk are often used in other dishes, he would like to know the dishes in which eggs or milk were used during the period and the quantity used of each. The same households were contacted immediately after the campaign and were asked for the same information as before the campaign. See Table 1.

[3] For further details see H. B. Bylund and R. L. Baker, *A Community Program to Increase Egg Consumption*, Pennsylvania Agricultural Experiment Station Progress Report 145, March 1956; and H. B. Bylund and R. L. Baker, *Effectiveness of Techniques used in a Better Breakfast Program*, Pennsylvania Agricultural Experiment Station Progress Report 146, April 1956.

TABLE 1. EGG CONSUMPTION AS REPORTED BY SAMPLE HOUSEHOLDS FOR TWO PERIODS OF TWO DAYS EACH, WAYNESBORO AND BLOOMSBURG, PENNSYLVANIA

	Number of households	Eggs used* per family before campaign	Eggs used* per family after campaign	Percent change in eggs used
Waynesboro (test city)	187	4.7	6.4	36.2**
Bloomsburg (control city)	190	4.4	4.6	4.4***

* The first survey was taken in Waynesboro during the first three days of the week ending January 8, 1955, prior to the beginning of the program and was taken in Waynesboro the first three days of the week ending February 12, 1955 and in Bloomsburg the last three days of that week.

** Significant at the .001 level based on "t" test for paired differences.

*** *Not* significant at the .05 level based on "t" test for paired differences.

The manager of each of the retail grocery stores in the community was contacted and asked to report sales of eggs each week. Managers of 19 of the 20 retail stores (including two poultry markets and one dairy store) agreed to furnish the information. Fifteen of these 19 stores reported sales for the entire period. Double postcards were used to facilitate reporting. They were placed in the mail each weekend so they would be received on Monday for reporting of the previous week's sales. If the card had not been received from a store by the time the second one was due, the store was visited to obtain the information.

High variations in sales occurred among stores, among weeks for individual stores, and among weeks for all stores. Table 2. One small independent store sold as few as seven dozen eggs one week. In the same week one of the chain stores sold 912 dozen eggs. On the average, the highest sales for individual stores were 64 per cent above the lowest sales for the same store during the record period. Few of these differences could be associated with eggs being used as a price feature. Combined sales for all stores were 25 per cent higher in the week of highest sales than in the week of lowest sales. Egg sales for the week just prior to each survey were used to compare with the results of the consumer survey.

Accurate records of egg sales are not ordinarily kept by retail grocers and discussions with some of them after the study revealed that the figures they sent as weekly sales were at times estimates because they had "lost track" of the exact amounts. One was retailing eggs as well as wholesaling them to other grocery stores. There were times when he wasn't certain how many eggs had gone into each channel. Another retailer obtained eggs from a huckster who sold eggs from door to door and left the retailer those he didn't sell. This retailer admitted that there might have been some error in his record of the number of eggs he had obtained and that at times he ran out of eggs to sell.

TABLE 2. WEEKLY EGG SALES AS REPORTED BY RETAIL GROCERS WAYNESBORO, PA., 1955 (DOZENS)

Store	Week ending					
	Jan. 1	Jan. 8	Jan. 15	Jan. 22	Jan. 29	Feb. 5
1	723	911	601	912	650	519
2	623	630	611	564	559	537
3	233	153	170	197	189	178
4	210	230	258	240	231	243
5	75	87	94	89	96	87
6	71	66	60	74	63	61
7	57	64	76	58	72	82
8	53	100	100	145	111	65
9	51	79	61½	55	38	74½
10	45	40	35	43	30	35
11	30	30	30	30	30	30
12	30	30	20	20	25	25
13	30	45	30	30	30	35
14	28	18	44	29	31	17
15	8	10	7	7	14	12
Total	2,267	2,493	2,197½	2,493	2,169	2,000½

It did not appear that these sources of error or those that might be normally expected in a consumer survey accounted for the difference between the two methods in the apparent change in egg consumption. Therefore, consumers, hucksters and producers in the Waynesboro area were also contacted in an attempt to discover reasons for the differences in the methods. Consumers who bought eggs from non-store sources were asked for the names of their suppliers. These people (hucksters and producers) were asked about recent changes in sales to regular customers and about the addition of new customers.

A shift in source of supply from store to non-store sources could be partial explanation for the differences noted in the two methods of measurement. Although concrete proof was lacking there were evidences to support this hypothesis. A manager in one of the larger stores pointed out that when egg prices rose he could not compete with local eggs so he did not offer Grade A eggs but continued to offer the lower priced Grade B eggs. Eggs from non-store sources were generally cheaper than those sold in stores. Since there was a price rise during the campaign period some consumers probably shifted to a cheaper non-store source of supply. Furthermore, since this one large store eliminated Grade A eggs during this period, potential egg sales likely were reduced as a result of those who preferred Grade A eggs seeking other sources of supply.

Hucksters whose income depended largely on the sale of eggs, showed more interest in the program than most grocers. This interest could well have led to increased activity by the sellers on egg routes and this in turn may have resulted in their obtaining a larger share of the market.

Among the several hucksters and producers visited, only a few kept accurate records of egg sales. One huckster, who had better records than most, was enthusiastic about the campaign. He thought his sales had increased as much as 50 per cent. A check of his records, however, showed an increase of about 15 per cent.

One small producer-retailer stated that it was difficult to tell if individuals increased their egg consumption since she didn't know how many eggs regular customers were buying for others. She often ran out of eggs and sent her excess customers to a neighbor. If that neighbor didn't have enough "they go up the lane and get from Mr. H." He was a large producer who retailed eggs only to consumers who came to the farm to buy them.

No question was asked on source of supply of eggs on the first survey. On the second survey the respondents were asked where they "usually" bought their eggs. They were not asked how long they had been getting them from that source or about alternative sources. However, more than 60 per cent of the consumers were getting most of their eggs from non-store sources. These consumers ate more eggs than those buying most of their eggs from retail stores. These obtaining "most" of their eggs from non-store sources showed the greatest increase during the campaign.

A third survey was made in Waynesboro in the spring of 1956, 15 months after the better breakfast program, to test the long-run effects of the program on egg consumption.[4] At this time homemakers were asked detailed questions concerning how and where they obtained their eggs. The results point up the complexities of retail marketing of eggs and help to explain differences between store data and a consumer survey.

The crux of the measurement problem appears to lie in the fact that homemakers shift their sources of egg supply and also obtain many eggs from non-store sources. In answer to the question as to where they "usually" obtained their eggs, 36 per cent of the respondents mentioned retail stores while the remaining 64 per cent mentioned various non-store sources. Table 3.

It would be expected that in a small city in an area producing poultry and eggs many consumers might bypass regular retail stores. However, this city is not as atypical as one might suppose. Among 21 studies listed in a compilation by the Production and Marketing Administration of the U. S. Department of Agriculture, on the average 37 per cent of the consumers purchased "most" of their eggs from retail stores. These included dairy stores, poultry markets and meat markets. These studies included one in Minneapolis in 1947 and one in Chicago in 1948. Even in cities

[4] H. B. Bylund and R. L. Baker, *Long-Run Effects of a Better Breakfast Program*, Pennsylvania Agricultural Experiment Station Progress Report 167, March 1957.

TABLE 3. WHERE EGGS WERE "USUALLY" OBTAINED, WAYNESBORO, PENNSYLVANIA, SPRING, 1956

Source	Number of families	Percent of families
Store	78	36.3
Non-store		
Delivered direct	46	21.4
Go to country	33	15.3
Delivered at work	10	4.7
Obtained by friend or relative	27	12.6
Miscellaneous	21	9.7
Totals	215	100.0

of this size, only 44 per cent and 48 per cent of the consumers, respectively, were purchasing "most" of their eggs from these retail sources.[5]

This is only part of the picture, however. To add further difficulties to the problem, most consumers have an alternate source from which they obtain eggs from time to time. In the present study, only 7.9 per cent of the consumers purchased all eggs from a particular store and an additional 15.8 per cent bought all eggs from stores in the previous six months. About 13 per cent "usually" bought them from a store but had also obtained eggs one or more times from a non-store source in the previous six months. About 29 per cent obtained them from non-store sources most of the time but had made one or more store purchases of eggs in the past 6 months.

Consumers who "usually" bought their eggs from non-store sources were more likely to stick to one source of supply. Nearly 47 per cent of

TABLE 4. ALTERNATE SOURCE FROM WHICH EGGS HAD BEEN OBTAINED IN LAST SIX MONTHS, WAYNESBORO, SPRING, 1956

		Alternate source of eggs			
		Store alternate	Non-store alternate	No alternate	Total
Families who "usually" obtain eggs from store	Number	34	27	17	78
	Percent	43.6	34.6	21.8	100.0
Families who "usually" obtain eggs from non-store source	Number	62	11	64	137
	Percent	45.3	8.0	46.7	100.0
All families	Number	96	38	81	215
	Percent	44.6	17.7	37.7	100.0

[5] *Some Highlights from Consumer Egg Studies,* Agriculture Information Bulletin No. 110, Production and Marketing Administration, USDA, 1953.

TABLE 5. COMPARISON OF SOURCES OF EGGS, TWO CITIES OF 10,000 POPULATION, SPRING, 1956

	Source of eggs				
	Store(s) only	Store main source, non-store alternate	Non-store main source, store alternate	Non-store only	Total
	Waynesboro, Pennsylvania				
Number of families	51	27	62	75	215
Percent of families	23.7	12.6	28.8	34.9	100.0
	Bloomsburg, Pennsylvania				
Number of families	44	30	68	80	222
Percent of families	19.8	13.5	30.6	36.1	100.0

consumers who bought eggs from these non-store sources had no alternate source of supply. Only 22 per cent of those who "usually" used a store source for eggs had no alternate source. Table 4.

The habits of Waynesboro consumers in egg purchasing is not an isolated case. A city of similar size and population characteristics, Bloomsburg, Pennsylvania, was used as a control city for the various phases of the study. Alternate sources of supply in that city were similar to those of Waynesboro, Table 5. About 20 per cent of the consumers in Bloomsburg had purchased eggs only at stores during the past 6 months compared with 23.7 per cent in Waynesboro. On the other hand, 44.1 per cent of the consumers in Bloomsburg had purchased eggs from both store and non-store sources during the past 6 months compared with 41.4 per cent of the consumers in Waynesboro.

When the Waynesboro consumers were asked why they purchased eggs at an alternate source rather than from their usual source of supply, 42 per cent of the homemakers using an alternate source stated that they had run out of eggs, 16 per cent bought them with groceries, 9 per cent stated that the "usual" source had run out of eggs and 6 per cent men-

TABLE 6. REASONS GIVEN FOR USING ALTERNATE SOURCE FOR OBTAINING EGGS, WAYNESBORO, PENNSYLVANIA, SPRING, 1956

Reason	Number of families	Percent of families
Ran out of eggs	57	42.4
Bought with groceries	21	15.7
Usual source ran out of eggs	12	9.0
Usual source less convenient	8	6.0
Miscellaneous	30	22.4
No reason given	6	4.5
Totals	134	100.0

tioned that the "usual" source was less convenient. The others were miscellaneous answers or they gave no reason. Table 6.

Conclusion

There are many sources where eggs may be obtained by consumers. The retail store is one class of these sources. The system is open so that consumers can and do shift from one source to another to suit their immediate situation and needs. This being the case, records of sales of eggs from retail stores would not necessarily give an adequate index of egg consumption in the community. Other things being equal, a consumer survey should give a more accurate measure of the effectiveness of an overall program to change demand for commodities that may be purchased from non-store sources. This is particularly true if specialized retailers become interested in the program. Their close contacts with consumers permit them to "talk up" the program and thus affect their sales and the consumption of their customers.

RESEARCH IN THE DYNAMICS OF ECONOMIC DEVELOPMENT IN THE ALLUVIAL VALLEY OF THE LOWER MISSISSIPPI RIVER

ROBERT W. HARRISON[1]
Agricultural Research Service

THIS is the third in a series of papers on research in land economics in the Alluvial Valley of the Lower Mississippi River. The first report outlined the physical nature of the reclamation problem in the lowlands of the Mississippi Valley.[2] The problems of flood control, land drainage, and land clearing were emphasized. Studies of these aspects of land development have been completed. In the second report on research underway, emphasis centered on settlement experince in the Alluvial Valley.[3] The researches outlined in the second report are completed or nearing completion and research in land economics has been turned toward a series of new problems. These problems are new in the sense that they are current, but in the sense that they are outgrowths of the long history of efforts to reclaim and build a permanent society in the vast floodplain of the Mississippi River, they are old. Specific attention is now directed toward the developing agriculture and industry of the valley.

The presence of the federal flood-control program, the effective action of the states toward the development of a sound drainage program, and the development of equipment capable of clearing bottom lands of trees, stumps, and brush has made possible expansion of settlement in the valley in several directions. The character of the expansions and some of the problems involved are outlined here. Research is underway on these aspects of development and on a summary of land economics research in the lower Mississippi Valley.

Refinement of the Reclamation Program

Mention should be made of the costs and responsibilities that success in reclamation has exacted. The chief lesson from the 250 years of effort to control floods on the Mississippi River is that flood control is never absolute, and that even relative freedom from overflow requires constant study and expense. The possibility of flood must underlie all sound economic and social planning in Alluvial Valley. Agricultural interests have

[1] Agricultural Economist, Farm Economics Research Division, Agricultural Research Service, USDA.

[2] "Land Economic Research in the Alluvial Valley of the Lower Mississippi River," *Journal of Farm Economics*, Vol. XXIX, No. 3 (August, 1947.)

[3] "Research in Land Development and Land Settlement in the Alluvial Valley of the Lower Mississippi River," *Journal of Farm Economics*, Vol. XXXIV, No. 1 (February 1952).

shouldered the burden of floods, and as the valley grows in industry this segment of the economy must grow in awareness of the flood problem and must share the burden. The great areas subject to backwater flooding associated with the entrance of the major tributaries of the Lower Mississippi River are one of the disadvantages of flood control. Enlightened use of these areas is a must in successful development of the valley. In many areas drainage too has reached the point of marginal development, and increases in the number of costly operations for clearing and dredging delta streams should be studied carefully. The era has passed when general drainage projects are almost certainly worthwhile. Increasing selectivity should mark this phase of expansion. This is true also of many land-clearing projects. Benefit-cost analysis will be needed increasingly as the reclamation program is refined. This type of analysis, for example, may be useful in making decisions in the important river-bank stabilization program. The loss of valuable riverfront lands must be balanced against the cost of concrete-revetment and other engineering works needed to hold the Mississippi and major tributaries to a relatively fixed course. Knowledge of the kinds of costs and benefits involved in the bank-stabilization program is needed in making this complex problem understandable to a wide audience. Research toward this end is being planned.

The reclamation program must be refined to meet specific needs. Thus future efforts toward reclamation will be differentiated from past efforts which sought generalized flood control, drainage, and related social services. One task of the land economist is to estimate the degree of reclamation that is needed for various types of economic activity. Industries that require a high degree of flood protection frequently locate in areas of rather limited protection, often under the mistaken idea that the levee program as now designed is absolute in its operation. This is true also of various types of farming. A dairy industry, for example, justifies a higher degree of reclamation, particularly flood control, than a cotton or rice economy. Urban developments also are being made without the special protection and precautions they justify.

The refinement of the vast system of engineering that protects the Alluvial Valley of the Mississippi from river floodwater is a major challenge for the next half century. If this challenge is to be met without disaster, rapid progress must be made in understanding the safe and rewarding direction for physical and socio-economic expansion of the delta.

Intensification of Social Organization

Studies of the organizations developed in the history of Mississippi Valley reclamation have been an important part of land economic re-

search. Each part of the flood-control and drainage organization, as well as the organization of the sugarcane and cotton enterprises has a long record of service to alluvial land. The history of the levee boards of the Mississippi Valley is especially interesting. But in its physical and cultural development the Alluvial Valley is entering a period in which new types of social organization and intensification of the existing physical, economic, and social services are needed. The diversification of agriculture, the growth of industry, and the development of a sustained-yield forest economy requires a high level of community planning. It also requires enterprise organization of a different type than that found on the traditional sugarcane and cotton plantation. Land economists have an important task in the designing of institutions that will best serve the expanding economy of the Alluvial Valley. This work has many fascinating aspects.

Economic and social development in the Mississippi Valley is taking diverse forms. In French Louisiana, the subsistence economy of the Acadians is giving way to a suburban economy. Many rural people are employed in the growing oil, sulphur, salt, and related Gulf Coast industries. In the great Tensas basin of Louisiana and Arkansas, extensive ranching enterprises are developing. Many of these are owned by Oklahoma and Texas cattlemen who have fled the dry weather and reduced range of the Southwest. In the alluvial lands of southeastern Missouri, the family-type farm common to the Corn Belt is becoming established. The dominance in economic and community affairs of the traditional sugarcane and cotton plantations, with their distinctive labor organization and social structure, is giving way to newer economic and social patterns. Are the organizations that control vital phases of reclamation keeping pace with the growing needs of the Valley? Relying as it does upon a complex engineering system for protection and development, the valley must coordinate its resource use, control and development planning.

Factors Currently Influencing Land-Development Trends

Of the many forces that shape land development in the Alluvial Valley, those related to the reclamation problem and to the institutional aspects of land settlement were emphasized by earlier studies in this series. These forces continue to be important. The land ownership pattern inherited from the circumstances of settlement remains one of the controlling factors in the development of the Valley. But here we outline other aspects of the development problem not emphasized in previous reports.

With the diversification and mechanization of Mississippi Valley agriculture, land selection has become increasingly important. The matching of crop varieties to soils and drainage conditions is now complicated by

the fact that mechanized equipment works differently under various soils and moisture conditions. Study and classification of alluvial soils to a degree not previously known is now a characteristic of "delta" farming. Development of improved pasture and sustained-yield forestry is as dependent upon successful selection of soils and sites as is production of crops. The development of backwater areas and lands outside the levee presents special problems of classification which involve flood-height-damage relationships for various types of trees and grasses. Lack of knowledge of complex soil and topographic characteristics is a limiting factor in Alluvial Valley development. Economic classifications of the type needed are not generally available, although some plantation companies have arranged for special study of their properties and of prospective purchases. This is one aspect of the refinement that is taking place in the economy of the Alluvial Valley.

Paralleling the increased specialization in land use is the tendency toward specialization of the labor force. The migration from the Alluvial Valley of thousands of the younger and more capable Negro farm workers and the movement of many farm workers to nearby cities and villages have made it necessary to reconsider the role of labor in the economy. The availability of trained labor for mechanized farming, and of labor with knowledge of livestock and diversified farming is increasingly a factor in shaping agriculture in the valley.

Changes in land use and in labor organization and management are forcing new concepts of the role of managers in southern agriculture, and particularly in the Alluvial Valley. The enlargement of engineering functions, the development of complex conservation practices and economic controls, require new types of management. The gradual rise of a manager group interested in innovations, in experimentation, and in new concepts of labor management is profoundly influencing the use of reclaimed lands. In turn, these influences affect the motives for land holding and ownership. With the breakdown of the traditions that surround land ownership, the roles of merchants and banks are changed. Thus it is proper to speak of the dynamics of land development.

The growth of the industrial and commercial community also influences delta agriculture. Rural residences and family farms draw support from the growing urban community. The appraisal of these influences as they affect development of the land resource is one of the principal objectives of land economic research now underway.

Leadership and Social Action

The role of labor, the character of management, the sources of credit, the motives for development, and the concepts of standards of living are

changing. If the opportunities for genuine social progress inherent in the changing agriculture of the Alluvial Valley are to be realized, means for effective community and regional planning must be devised. The trend toward individual action that was characteristic of plantation society impeded development of effective regional and local leadership and of the essential planning bodies through which leadership can be made effective. Without leadership and an effective planning organization, the responsibility of the Alluvial Valley toward its own welfare cannot be met. The land economist joins with other social scientists in exploring the problem of developing leadership and creating public and private agencies for integrated planning of regional and community development.

The chief economic and social forces that shape the economy of the Alluvial Valley of the Mississippi are better known and understood as a result of the growing volume of research and discussion of social and economic problems. To translate these results into effective action is the continuing task ahead.

Continuing Lines of Economic and Social Development

Contrasts that have characterized the Mississippi alluvial bottoms may be expected to extend into the future. The plantation as a method of organization has proved flexible. The forces for large-scale ownership and commercial management are powerful, and they have found new stimulation in the mechanized equipment of modern agriculture. The family farm in the Alluvial Valley also has a long history, and there are signs that it will become dominant in many parts of the delta, particularly if community planning for essential services is developed.

The staple crops—sugarcane, cotton, and rice—have a secure place in projections of future development, but they do not hold the dominant role they once occupied. Research in bottom-land hardwood forestry opens the way for a more effective forest-supported economy for the great backwater areas of the Mississippi Valley and for those lands outside the flood-control levees.

The drama of development involves familiar figures and practices, but it places them in interesting new relationships.

NOTES

A NOTE ON "ECONOMIC ASPECTS OF THE FARM WOODLAND ENTERPRISE"

SOLON BARRACLOUGH
Ames Plantation, University of Tennessee

FOR most farmers, there appears to be no economic incentive to invest in production of hardwood lumber" reports Redman on the basis of a Kentucky study appraising woodland as a farm investment.[1] If this dismal appraisal of the economic opportunities from farm forestry is correct, there should be few farmers who would not jump at the chance to sell their woodlots to one of the many lumber or pulp companies standing ready to pay a good price in order to assume the burden of ownership. The land buyers for timber-using industries are not finding farm woodland easy to acquire, however, and unless farmers are holding on to their woods out of pure sentiment this may suggest some error in Mr. Redman's analysis. Conclusions are seldom better than the assumptions and data which they are based. I wish to point out some inadequacies in Redman's data on forest productivity and to question his assumptions on prices, costs and risks. Also, his method of analysis would not justify such sweeping conclusions even if his data and assumptions were correct.

Redman's estimates of forest productivity were made by measuring trees of various ages in woodlands of the Eastern Pennyroyal Area of Kentucky. If the statistical sampling and analysis are correct, his data should approximate the potential timber yields on similar sites for similar stands that have undergone a similar history of growth and management. A serious objection to using these data in appraising the opportunities from farm forestry is that the measurements were made in woods that had not been protected or managed during their development. It is becoming increasingly clear that annual merchantable production per acre can be increased greatly through adequate protection and cultural measures such as improvement cuttings and thinnings. Such measures increase the rate of growth, concentrate growth on the most valuable trees and enable the owner to market through intermediate cuttings timber that would otherwise be wasted. In addition, volume growth alone is a poor measure of hardwood timber production because seemingly small differences in tree quality may result in variations in stumpage prices of several hundred percent. Woodland management has an even

[1] John R. Redman, "Economic Aspects of the Farm Woodland Enterprise," *Journal of Farm Economics*, Vol. 38, No. 4, November 1956, pp. 901-910.

greater effect on hardwood timber quality than on volume yields per acre. It is no more meaningful to discuss the economics of the farm woodland enterprise without considering the influence of management than to talk about the economics of the livestock enterprise without considering any of the techniques of pasture management at the farmer's disposal.

The reader of Redman's article is likely to be left with the impression that this data indicate the range of physical productivity of most hardwood sites although he does state that the study was limited to the Eastern Pennyroyal Area. He should have pointed out that this area is one of relatively slow hardwood growth. Data from Mississippi Valley woodlands, for example, show woodland productivity even for unmanaged stands often to be more than twice as great as that reported by Redman for his best sites.

The price assumptions used in the analysis bear little relationship to reality. Redman assumes a stumpage value of $10 per 1,000 board feet. Actual stumpage prices prevailing for hardwood timber during the last 15 years have averaged much higher than this where the timber was competitively sold. On the Ames Plantation in West Tennessee the average stumpage price of more than 2 million board feet of hardwood timber sold since 1954 has been $56 per 1,000 feet and the range in prices for individual stands due to timber quality, size, species and accessibility has been from $10 to considerably more than $100 per 1,000 board feet.

Not only is the assumed price level too low, but the author also ignores the long-term trend in timber prices. The index of lumber prices relative to the prices of other commodities (1926 = 100) has increased from 67.9 in 1900 to 194.0 in 1954. The secular upswing in relative prices of timber has been extremely steady and recent studies of the future demand and supply for forest products indicate that it will continue for at least the next 50 years. By merely assuming more realistic prices the rates of return from farm woodland investments would appear much greater than the 2¼ percent to 4 percent arrived at in the article.

I fail to see how Redman obtained his estimates of costs. In his discussion he mentions an establishment cost of $10 per acre and the cost curves in his diagram are evidently based on this assumption. A hardwood stand usually costs nothing to establish because the trees start from natural seeding and sprouting. If he is assuming the initial value of the land as a cost, it hardly seems correct to treat it as a marginal cost of the woodland enterprise as the farmer presumably already had this investment as part of his farm. If, on the other hand, he is assuming that the farmer is using cultural practices costing $10 per acre to assure stand establishment it would be logical to believe that the stand would

remain under continuous management. In that case the cost curve would have to reflect additional investments in improvement work while the revenue curve would have to be adjusted to reflect the increased volume and value of yield from a managed stand. Could it be that Redman's cost curve is not based on empirical data?

The article stressed the risks involved in predicting timber yields and prices. These risks may be less than imagined. There is probably less risk in predicting the long-term trend of timber prices than in predicting next year's or next month's price of eggs or hogs. Timber is a commodity that will continue to increase in value on the stump while the owner waits for a propitious time to market it. The physical increment per year is a biologically determined quantity conditioned by site and management that can be estimated with increasing accuracy as forestry data improve. Even the risks from fire or insect damage are not great in hardwoods; fire protection is improving rapidly and if such damage does occur the timber can usually be salvaged without much loss. Further study might show that from an actuarial viewpoint the woodlot is one of the least risky farm enterprises.

Finally, a word on Redman's method. He does not analyze the farm woodland enterprise as a part of the total farm operation. Actually, the woodland enterprise can often make its biggest contribution to net farm income by providing slack-season employment for farm labor and machinery. Many farmers can profitably supplement their crop and livestock enterprises through well-planned work on improvement and harvesting in their woods. If the economics of the beef cattle enterprise, for instance, were appraised without reference to the whole farm operation, as was the woodland enterprise, it is at least questionable whether its returns for Southern farmers would appear at all profitable.

Redman does perform a service by stressing that the high return sometimes to be obtained from additional capital in other farm enterprises will often encourage heavy cutting of farm timber. This condition, however, usually reflects ignorance of the opportunities in forest production, poorly organized or too small farm units and lack of adequate agricultural and forest credit.

In any case, the data presented in his article do not show that there are inherent economic disadvantages in the farm woodland enterprise.

ON FARM WOODLOTS: A REPLY*

JOHN C. REDMAN
University of Kentucky

THE marginal value productivity of effort spent in preparing rejoinders in general seems to be low to researchers. Nevertheless, the criticism[1] of my recent article[2] could not be ignored. Thus, the purpose of this paper is to provide a reply and to elaborate upon some points of interest on the economics of the farm woodlot.

The Physical Data

In examining the literature on the physical productivity of woodlots over time, one immediately finds a dearth of information, particularly for hardwoods. Good productivity data are essential in appraising the value of farm woodlots as an investment and constant effort should be made toward the improvement. The data questioned by Barraclough were obtained from a sample of 350 plots of ⅛ acre on 47 farms in the Eastern Pennyroyal Area of Kentucky.[3] The variability of the data was reduced by sorting the plots into groups fairly uniform with respect to specie composition, density of stand, and quality of site. From these groups, 150 plots judged to be adequately stocked were used for detailed study. The plots which had fairly uniform specie composition[4] and adequately stocked stand (above 75 percent stocked) on the 3 site qualities were used in gathering the physical productivity data. A trained forester with many years of experience in harvesting, logging, milling, etc., assisted throughout the study.

Barraclough infers that the data are much too low but admits that the area is one of relatively slow hardwood growth. The data reflecting this slow growth cannot be checked against Mississippi Valley woodland data because of the influence that site quality (and maybe specie composition) has on productivity. The site qualities of the two areas certainly cannot be considered comparable.

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* The investigation reported in this paper is, in part, in connection with a project of the Kentucky Agricultural Experiment Station and is published by the permission of the director.

[1] Solon Barraclough, "A Note on 'Economic Aspects of the Farm Woodland Enterprise,'" *Journal of Farm Economics*, Vol. 39, No. 3, August 1957.

[2] John C. Redman, "Economic Aspects of the Farm Woodland Enterprise," *Journal of Farm Economics*, Vol. 38, No. 4, November 1956.

[3] See William B. Back, John C. Redman, Benn L. Hornbeck and Paul S. McComas, *Economics of the Farm Woodland in the Eastern Pennyroyal Area of Kentucky*, Bulletin 650 (Lexington: Kentucky Agricultural Experiment Station). October 1956.

[4] The specie composition was oaks 40 per cent; hickory, beech, yellow poplar, and hard maple 10 per cent each; all other species combined 20 per cent.

Barraclough is right in saying that quality is an important factor in hardwood timber production and this was fully recognized in the statement, "Quality, an important factor in growing timber, lags behind the annual increases in physical volume. Therefore, both volume and quality must be considered simultaneously. . . ." Also, in the discussion on productivity and revenue curves a footnote was made which read "The lag in quality if reflected in revenue is a factor causing the rate of increase of total revenue to be different than that of physical volume. This will not be considered here." A person using the scientific procedure in research has the right to recognize that such a problem exists and then state that it will not be considered in the study. This performs the very useful function of limiting the study to manageable proportions.

Management

Barraclough objects to using the data because the "woods had not been protected or managed through their development." Perhaps the farmers did not possess and apply all the skill and technical knowledge possible (nobody does). It still doesn't prove the woodlots were completely neglected. The farmer is not likely to hire professional woodlot manager when most of the farms have less than 25 acres. Instead, he is likely to do it himself while managing the rest of his business. Learning to manage a woodlot comes at a cost to him and he must balance this value-cost ratio against the value-cost ratio of learning to manage all other activities. With prospects of earning high returns for other enterprises relative to the farm woodlot, as Barraclough recognizes, he would logically spend most of his time learning to manage those that promise greater returns.

Economic Implications

Barraclough is right in saying that a single farm enterprise such as farm woodlot can not be considered independently of all other enterprises. Schedules on complete farm business of each farm were obtained to aid in appraising the woodlot as a part of the total farm operation, which Barraclough said was not done. When this was done, the woodlot enterprise did not fare so well. Farms in this area were short on capital and land. Additional capital invested in crop and livestock enterprises, as Barraclough agrees, yields high returns. Since these farmers seem to prefer the security afforded by debt-free productive assets, the stock of timber, which they conclude is producing a low return on the capital, provides a ready source of capital for other purposes.

The major flaw of Barraclough's criticism throughout his note is his failure to recognize the theory of alternative cost, a valuable and essential concept in economic analysis. This is especially evident when he says

"a hardwood stand usually costs nothing to establish. . . . If he is assuming the initial value of the land as a cost, it hardly seems correct to treat it as a marginal cost of woodland enterprise as the farmer presumably already had this investment as a part of his farm." The major farm resource to be employed initially in the production of timber is land, and the cost of land so used is at least that value forgone in the production of other crops or other uses. The fact that a farmer already owns a piece of land as a part of his farm does not eliminate this cost if there are other uses for the land.

The figure of $10 per acre was questioned as being much too high and inferred that it wasn't based on empirical data. The cost arrived at was the minimum alternative cost faced by the farmer and was based on net rental rate of unimproved pasture at 50 cents per acre which capitalized at 5 percent would give a land value of $10. This means that the land is worth $10 per acre for unimproved pasture and would constitute a $10 cost to the farm woodlot. Most farmers have a higher alternative cost than this since they are short on land for livestock grazing and for crops. Thus, for those farmers the cost curves will shift upward. Also, if the annual expenditures for care were included, the cumulative cost curves would rise much faster. In either case the return on investment discounted to the present would be less. If anything, the cost is on the conservative side.

It is always a problem to know what set of prices to use even in short-term farm budgeting, but in long-run planning such as investing in timber some average or long-run equilibrium price over time provides a basis for future expectations. Barraclough apparently thinks one should use a current stumpage price of $56 per 1,000 board feet as basis of valuing lumber being produced 60 to 100 years hence. Timber prices depend upon the rate of investment in the building and construction industry, the supply and demand of products that compete with hardwoods, and the location of mills with respect to lumber-consuming centers. These variables, especially the first two, are in turn affected by governmental policy and the level of national income and employment. No one knows what these conditions will be 60 to 100 years from now, but Mr. Barraclough says that prices of lumber will continue to rise for at least the next 50 years. Just to predict a long-run trend in prices of lumber is not sufficient for individual farmers. Such a prediction fails to give the farmer the relative trends of other investment opportunities. Also, prices can deviate and stay below the trend line for considerable length of time—even for the entire life of the farmer—and still have a long-run upward trend.

The average lumber prices by years from 1904 for the state, weighted

according to the importance of each specie in the sample, provided the basis for the figure used. This means that oak, hickory and beech, which are low in value, carry heavy weights in the process of weighting. It is true that the competitive prices for hardwoods have been somewhat above $10 in the last 15 years, but should they be used in planning for a time span of 60 to 100 years?

Finally, the facts remain that productivity of hardwoods in this area is low and the returns from additional capital and land used in other enterprises are high. The time-preference pattern for the family is often such that present consumption is preferred over that of 60 to 100 years hence. When these situations prevail, farmers wisely want to disinvest or refrain from investing more in the woodlot and place their limited resources in more productive activities. Mr. Barraclough says the farmers are ignorant of opportunities in forest production when they do this, but to this researcher, at least, they are just using good economic sense.

A COMMENT ON MR. REDMAN'S REPLY

SOLON BARRACLOUGH
Ames Plantation, University of Tennessee

THIS controversy points out the need for considering opportunities for forest production in alternative farm operating plans. It could easily be done by budget analysis or linear programming of farm-forest operating units. Of course, the data would have to be adequate, several intensities of forest management considered and the alternatives correctly perceived.

Such research would surely bring out the need for better long-term forest and agricultural credit. It is possible such studies might show that occasionally it is good economic sense for a farmer to neglect his forest resource. However, some of us who are acting in the dual capacity of farm and forest managers and planners will be surprised and embarrassed if the apparently profitable forestry portion of our business is found to be as unattractive as the agricultural alternatives for using most wooded areas.

One hopes that the economists making budget or programming analyses of production opportunities on farm woodland will use input-output data and price assumptions that are complete and realistic. It would be unfortunate if the custom became established of recognizing the importance of timber quality and then leaving this factor out of the analysis for the purpose of "limiting the study to manageable proportions."

Mr. Redman's long-term timber price fails to reflect the increasing de-

mand for wood products, the growing scarcity of good-grade timber, the rise in the general price level and the improvement in timber quality and species composition expected from management. If $10 stumpage is assumed, other prices and costs should be on a comparable basis. I suspect, however, that if economists used $.25 per hour labor, $5 per cwt. beef and $2 per cwt. milk in their farm planning they would be taken even less seriously than usual.

ALTERNATIVE METHODS OF USING PRODUCTION FUNCTIONS FOR MAKING RECOMMENDATIONS

THOMAS E. TRAMEL
Mississippi State College

ESTIMATION of production functions is but the first step toward determining optimum combinations of variable inputs. Traditionally the optimum combination has been determined for an unlimited capital situation and for producing specified levels of product. Little attention has been devoted (1) to determining the optimum combination of variable inputs that yields a specified marginal rate of return on money invested in the variable inputs, or (2) to determining the optimum combination of variable inputs subject to the restriction of a specified expenditure for variable inputs.

For a limited capital situation, the optimum combination for a specified marginal rate of return or the optimum combination for a specified expenditure is probably closer to the manner of thinking of many farmers than the optimum combination for a specified output. For example, when comparing alternative investment opportunities, a farmer may be interested in knowing the optimum combination of N, P, and K that yields a specified marginal rate of return for, say, cotton. Likewise, he may be more interested in the optimum combination of N, P, and K, that can be purchased with a given amount of money, than in knowing the optimum combination of N, P, and K to produce a specified amount of product.

An estimation of the production function:

$$Y = F(X_1, X_2, \cdots, X_n) \tag{1}$$

where Y denotes output and X_1–X_n denote variable inputs is naturally required for either of the alternative techniques. If the optimum combination for an unlimited capital situation is to be determined, we solve the following system of equations simultaneously:[1]

[1] Negative values may be obtained in the solution to this system and the following systems of equations. If such a situation arises, the equations resulting from taking derivatives with respect to the variable inputs for which negative values are obtained should be omitted and a new solution obtained. None of the variable inputs for which negative values are obtained would be included in the optimum combination.

$$(2)\qquad \begin{aligned} \frac{\partial Y}{\partial X_1} &= \frac{P_{x_1}}{P_y} \\ \frac{\partial Y}{\partial X_2} &= \frac{P_{x_2}}{P_y} \\ &\cdots \\ \frac{\partial Y}{\partial X_n} &= \frac{P_{x_n}}{P_y} \end{aligned}$$

P_{xi}

where P_y denotes price of the product and P^{x_1} denotes prices of the variable inputs.[2]

If the optimum combination for specified output levels is desired, we solve the following system of equations simultaneously:[3]

$$Y = F(X_1, X_2, \cdots, X_n)$$

$$(3)\qquad \begin{aligned} \frac{dX_1}{dX_n} &= -\frac{P_{x_n}}{P_{x_1}} \\ \frac{dX_2}{dX_n} &= -\frac{P_{x_n}}{P_{x_2}} \\ &\cdots \\ \frac{dX_{n-1}}{dX_n} &= -\frac{P_{x_n}}{P_{x_{n-1}}} \end{aligned}$$

We need not dwell upon these procedures since they are the traditional techniques.

If the optimum combination for a given rate of return on the marginal expenditure is desired, we note first of all that when the marginal expenditure for each variable input just adds its cost to total returns, profits from the use of the variable inputs are at a maximum. Thus,

$$(4)\qquad \begin{aligned} P_y \frac{\partial Y}{\partial X_1} &= P_{x_1} \\ P_y \frac{\partial Y}{\partial X_2} &= P_{x_2} \\ &\cdots \end{aligned}$$

[2] Second-order conditions are assumed to be fulfilled throughout this note.

[3] Negative values in the solution also require the substitution of zero for the variable input in question into $Y = F(X_1, X_2, \ldots, X_n)$ before obtaining a new solution.

$$P_y \frac{\partial Y}{\partial X_n} = P_{x_n}$$

Hence,

$$\frac{P_y \dfrac{\partial Y}{\partial X_1}}{P_{x_1}} = 1$$

$$\frac{P_y \dfrac{\partial Y}{\partial X_2}}{P_{x_2}} = 1 \qquad (5)$$

$$\cdots\cdots$$

$$\frac{P_y \dfrac{\partial Y}{\partial X_n}}{P_{x_n}} = 1$$

is an alternative way of writing (2). To obtain a specified marginal rate of return on money invested in variable inputs, then, we may either multiply P_{x_1} in (2) by $(1 + r)$, where r denotes the rate of return, and solve simultaneously as before, or equate the terms to the left of the equality signs in (5) to $(1 + r)$ instead of to 1 and solve simultaneously as before.

If we wish the optimum combination of variable inputs for a specified expenditure on variable inputs, we note first of all that:

$$P_{x_1}X_1 + P_{x_2}X_2 + \cdots + P_{x_n}X_n = E \qquad (6)$$

where E denotes the specified expenditure, must hold. In addition, to be the optimum combination for given E, it is necessary for the marginal expenditure for each variable input to add the same amount to total returns, i.e.,

$$\frac{P_y \dfrac{\partial Y}{\partial X_1}}{P_{x_1}} = \frac{P_y \dfrac{\partial Y}{\partial X_2}}{P_{x_2}} = \cdots = \frac{P_y \dfrac{\partial Y}{\partial X_n}}{P_{x_n}} \qquad (7)$$

must hold. Relation (7) may be written alternatively as:

$$\frac{P_y \dfrac{\partial Y}{\partial X_1}}{P_{x_1}} = \frac{P_y \dfrac{\partial Y}{\partial X_n}}{P_{x_n}},$$

$$(8)\qquad \frac{P_y \dfrac{\partial Y}{\partial X_2}}{P_{x_2}} = \frac{P_y \dfrac{\partial Y}{\partial X_n}}{P_{x_n}}$$

$$\cdots\cdots\cdots$$

$$\frac{P_y \dfrac{\partial Y}{\partial X_{n-1}}}{P_{x_{n-1}}} = \frac{P_y \dfrac{\partial Y}{\partial X_n}}{P_{x_n}}$$

Solution of (6) and (8) simultaneously yields the optimum combination of variable inputs for the given expenditure.[4] It should be noted, however, that unless E chosen in (6) is less than the expenditure required for the quantities of variable inputs indicated in (2), profits from the use of the variable inputs could be as great or greater with a smaller expenditure.

In some instances—experiments with fertilizer rates in particular—product may originally be expressed as two or more separate functions, each involving a different (but only one) variable input. When such is the case *and in the absence of interaction among variable inputs,* the above procedures may be used, if first a "composite" function is obtained. The composite function may be obtained (1) by averaging the individual values for the Y-intercept[5] and (2) by adding together all other terms in all the separate functions. Similar techniques may also be used to obtain a composite function for situations where interaction was originally considered between certain variable inputs, say N and P, but not for others, say N and K, or P and K. All calculations resulting from the composite function would, however, rest on the assumption of *no interaction* where interaction was not originally considered.

[4] Optimum variable-input combinations for a given expenditure for two or more crops may be obtained by expanding (6) to include additional variable inputs and (8) to include additional outputs with the same variable input used for two or more crops being treated as separate variable inputs. Negative values arising in the solution should be handled in the manner indicated in a previous footnote.

[5] This value would enter into calculations only when the optimum combination for specified levels of output is being calculated.

THE WESTERN EUROPEAN MARKET FOR AGRICULTURAL PRODUCTS: MARKETING AND PRICE-STABILISATION

A. P. JACOBSEN
Formerly, Government Adviser, Copenhagen

THE international exchange of agricultural products is determined mainly by differences in the density of population and the degree of industrialisation. High density of population involves great demand; high industrialisation means great purchasing power.

Western Europe, from Norway to Greece, has a population of about 275 millions on about 160 million hectares of agricultural area, which means 1.7 inhabitant per hectare, and if Spain is excluded there will be 1.9, which is very nearly the density of population in China. As Western Europe is higher industrialised it can have, and has, a much larger consumption of animal foodstuffs than China, partly provided by the import of agricultural products, which is paid with industrial goods.

The imports comprises mainly commodities that require much land in production, such as grain, beef, mutton and dairy products, besides spinning and other agricultural raw materials obtained from thinly populated overseas regions. This import consists, amongst other things, of about 20 million tons of grain, about 3 million tons vegetable and animal fats and about 1.5 million tons of beef and mutton, but only small quantities of eggs and pork.

Western Europe includes, however, countries of very different economic structure. United Kingdom and Denmark constitute the extreme poles in regard to imports and exports.

United Kingdom is the predominant importer. With her 3.5 inhabitants per hectare and with only 5.5 per cent of the population belonging to agriculture, United Kingdom is the world's largest importer of grain, butter, cheese, beef mutton and pork. Formerly U.K. was also the world's greatest importer of eggs, but in recent years imports of eggs have shrunk heavily, because the home production has been extended on the basis of imported grain, and this was made possible by artificially high prices to the egg producers.

Denmark is the only country in Western Europe that has a large and genuine surplus of agricultural products. This is due to the fact that Denmark is a thinly populated country—1.4 inhabitant per hectare of agricultural area—with a large production per hectare. Only half of the plant production is used in Denmark, directly or indirectly. The other half is exported mostly in the form of animal products. Owing to Denmark's surplus, U.K. has greater imports of animal products than Western Europe taken in one, particularly of pig's meat.

If U.K. is not a party to the European market, the Continent, inclusive of Denmark, would with the present import of grain and of fat come down to a balance in her animal products. If Denmark is also kept outside, however, the rest of the Western European continent would experience a great and much increased import demand for all kinds of agricultural products.

This observation applies not least to a group as the six countries: Holland, Belgium, Luxemburg, France, Italy and Western Germany which, taken together, form the greatest market next to Great Britain. This group has 161 million inhabitants on about 80 million hectares, that is to say well over 2 inhabitants per hectare of agricultural area and most of them are heavily industrialized.

Denmark's agricultural export was distributed in 1955 by 49 per cent to Great Britain, 33 per cent to the countries of the European Coal and Steel Community, and 18 per cent to all other countries. To this must be added the unequal distribution of the export goods, as butter and pig meat are sold mainly to U.K., while beef, eggs and cheese are exported to the countries under the European Coal and Steel Community.

Thus it is only natural that U.K.'s plan to keep agricultural products apart from any agreement with the European Continent has aroused great unrest and concern within Danish agriculture. The possibility of a further increase of production on British soil is not, perhaps, very great, but a continued import of grain and feeding stuffs and preferences for the import of animal products from the Commonwealth-countries and Ireland may have a ruinous effect on Denmark's export.

The combination of the six countries into a free-trade territory with common customs duties also holds a very great danger to Denmark. As the territory requires an import of big quantities of agricultural products, the agriculture of the member countries will find a good market, and as it is obviously the intention to guarantee certain minimum prices the farmers may, in any case in the near futre, increase their production without fearing selling difficulties and price falls, while Denmark and other export countries that are outside the agreement are to bear the whole risk, as the import is blocked when the prices fall below the fixed minimum.

To an exporting country this is nearly the worst principle imaginable. In fact it is already practised to a rather large extent during the present state of affairs, as the purpose of placing obstacles in the way of imports is to regulate the imports to the markets in the importing countries so that the prices are maintained at a level that is considered reasonable both to producers and consumers. This regulation takes place in certain cases by quantitative restrictions, i.e. import quotas, in other cases by

protective duties. To take some examples. When Italy increases the duty on cheese, when Germany reduces the duty on offals, and France abolishes the duty on slaughter cattle or beef, these measures are virtually taken in order to regulate the import of the goods concerned, as this is the only way in which prices may be regulated. Customs duty is consequently also a quantitative restriction even if it is a movable one.

But it is exactly this principle that should be avoided. The aim of all international negotiations should be to agree to a joint production and price policy.

If the importing country will only open the door, when the goods are highly needed, and close it when the demand is covered, it is hardly justified to talk of internationl collaboration.

The market situation may also be illustrated as follows: Of the total plant production in each country a larger or smaller proportion is spent on the most urgent uses: sowing, human consumption (direct), and industry. All other plants and parts of plants may be summarized under the designation fodder rest. This rest is exploited through the livestock, but in densely populated and heavily industrialised countries the fodder rest is comparatively small, and such countries are therefore compelled to import fodder or animal foodstuffs or bigger or smaller quantities of both categories. The fodder is imported mainly as grain, because it is easier to transport than most other kinds of fodder. As a large quantity of the imported grain is used for human consumption a corresponding quantity of grain for fodder could be grown in Western Europe which otherwise would have to grow their own bread grain, and this could very well be accomplished as the requirement in these countries is less than half of the total grain harvest. Consequently the effect is the same, no matter whether the import consists of wheat or barley.

The actual competition originates from the overseas countries in the form of grain which gives rise to excess productions of pork and eggs, vegetable fats, which form the basis of the production of margarine, and beef and mutton.

A European marketing scheme must therefore presume coordination of the import of grain to the particular countries, and perhaps also of their import of vegetable fats. Further it would probably be necessary to have a common or anyhow a coordinated anti-dumping clause for products of animal origin. Thus it should not be impossible to adapt the production in the way that stable and reasonable prices of livestock products could be obtained. On the other hand it is utopian to expect free sale at stable and good prices for bacon and eggs, if the countries have unlimited import of grain. By way of example Denmark's import of 0.6 million tons of grain corresponds to 200 kg. per hectare of agricultural area, Germany's

import of 4.5 million tons to 300 kg., England's import of 7.5 million tons to 450 kg. and Holland's import of 1.7 million tons to 800 kg. per hectare of agricultural area.

A limitation of the grain import of the particular countries on the basis of their economic structure and previous import, would only mean that the last or outermost production units, termed marginals, particularly those of pigs and eggs, would be cut off. As these marginals give the lowest net profits and as it is those that cause the price falls the limitation would not result in any loss to the farmers concerned but would be an advantage. The arrangement would involve a certain "normal" distribution of the livestock production on a level with the demand, which at the same time would have a stimulating effect on the sale of industrial goods.

Actually, the scheme outlined above should not necessarily be detrimental to the agriculture of any of the participating countries. The national production and price policy might probably be rather independent, and the risk attending the storing both of grain and livestock products would be heavily curtailed, as there would be security for the production, in the long run, being adapted to the demand.

In fact an arrangement as that suggested would not be a loss to the grain-exporting countries either, as these cannot dispose of more grain than the importing countries may use with advantage.

The whole scheme would be an attempt at a *general production and price stabilisation* starting with the final products, namely the animal foodstuffs based on the fact that the utilization value of the fodder rest determines the prices, not only of the fodder but also of plant products for human consumption. The quantity of grain is deciding for the size of the livestock production, while the prices of livestock determines the price level of agriculture and of the income of the farmer. Only fair prices of livestock products will secure fair grain prices and afford a basis for keeping up the price of grain.

To this may be added that such stabilisation of production and prices within agriculture would afford a better sale of industrial goods in general and support the general economic expansion.

A NOTE ON LONG-RUN PRICE ELASTICITY

CONRAD GISLASON*
Washington State College

TWO reviewers[1] of *Demand for Meat*[2] suggest that Working has misinterpreted his own results. The reviewers reach this conclusion as a result of rewriting equations estimated by Working in a different form. As a result of the manipulation of these equations the coefficient of the regression of the average quantity consumed over the last five years (i.e., long-run quantity) on the yearly price turns out to be positive. Kuznets and O'Regan maintain that this coefficient is the long-run price elasticity. Since this is positive, the analysis, they conclude, cannot be valid. It is readily shown that if the long-run elasticity is to be more elastic than the short-run elasticity this coefficient must be positive and that Working is correct in his definition of long-run elasticity used in his estimated demand relationships.

In estimating the long-run effects, Working uses three variables. The current price and the current quantity consumed are entered into the estimation process as annual data and the long-run quantity consumed is defined as the average quantity consumed over the most recent five years. Long-run price can be substituted for the long-run quantity consumed without any change in the basic conceptual framework. To obtain the long-run price elasticity, the long-run price must be confronted with the long-run quantity taken. Kuznets and O'Regan fail to take this into account. They maintain that the effect of the long-run quantity consumed on the current annual price (the current quantity consumed being held constant) is the long-run elasticity. In fact, they have mistakenly taken the coefficient of a shift variable (namely, the long-run quantity consumed) for the short-run demand curve as the long-run price elasticity.

Represent the current short-run demand relationship, which is to be estimated, as follows:

$$X_{1,t} = a_0 + a_2X_{2,t} + a_3X_{3,t-1}$$

where X_1 is the current price,
X_2 is the quantity consumed in given or current year,
X_3 is the average quantity consumed over a given number of preceding time periods including the current time period. In the

* Acknowledgement. Professor Working did much to clarify my thinking on this problem. However I bear full responsibility for the formulation here presented.

[1] G. M. Kuznets, "Measurement of Market Demand with Particular Reference to Consumer Demand for Food," *Journal of Farm Economics*, Vol. XXXV, No. 5 (Proceedings Number), December 1953, p. 887. William G. O'Regan, "Demand for Meat," *Ibid.*, Vol. XXXVII, No. 4, November 1955, pp. 752-755.

[2] Elmer J. Working, *Demand for Meat*, University of Chicago Press, 1954; "Studies in the Measurement of Demand with Special Reference to the Demand for Meat," Ph.D. Dissertation, Harvard University, March 1952; "Appraising the Demand for Agricultural Output During Rearmament," *Journal of Farm Economics*, Vol. XXXIV, No. 2, May 1952, pp. 206-224.

short-run demand equation above X_3 is lagged one time period to indicate that the current X_2 is not included in the average or long-run quantity. Thus, the current quantity enters only once into the demand relationship. For illustrative purpose let us use five years as the time involved to get the long-run variables. In symbols, therefore,

$$X_{3,t} = \frac{\sum_{t-4}^{t} X_{2t}}{5}$$

X_4 is defined as the average price for the same years as X_3 is averaged. It is quite evident that X_4 is dependent upon this functional relationship. We have

$$X_{4,t} = \frac{\sum_{t-4}^{t} X_{1t}}{5} = \frac{5a_0}{5} + \frac{\sum_{t-4}^{t} a_2 X_{2,t}}{5} + \frac{\sum_{t-5}^{t-1} a_3 X_{3t}}{5}$$

$$X_{4,t} = a_0 + a_2 \frac{\sum_{t-4}^{t} X_{2t}}{5} + a_3 \frac{\sum_{t-5}^{t-1} X_{3t}}{5}$$

$$X_{4,t} = a_0 + a_2 X_{3,t} + a_3 \frac{\sum_{t-5}^{t-1} X_{3t}}{5}$$

This gives the average price over the specified number of preceding years as a function of the average quantity consumed and previous average quantities. This relationship is the basis for determining the long-run demand. If we define the conditions of long-run demand to be fulfilled when

$$X_{3t} = \frac{\sum_{t-5}^{t-1} X_{3t}}{5}$$

then the long-run demand curve can be written as

$$X_4 = a + (a_2 + a_3) X_3$$

This states that the slope of a long-run linear demand relationship is equal to the slope of the short-run demand curve (namely, a_2) plus the shift coefficient for the short-run demand curve attached to the long-run variable (namely, a_3). If the variables are expressed as logarithms of the observed data then this relationship holds for the elasticities.

Suppose it were desired to hold the quantity available on the market constant until the price X_4 were stabilized at its long-run level. Then the long-run demand relationship indicates that it would take twice the number of years over which the long-run variable is averaged plus the lagged interval of X_3 to attain this condition. Setting X_2 at a new level and holding it constant at that level, it would take eleven years for the following equality to result:

$$\frac{\sum_{t-4}^{t} X_{2,t}}{5} = X_{3,t} = \frac{\sum_{t-5}^{t-1} X_{3,t}}{5}$$

This, however, overstates the time required to display the long-run price by the use of the long-run quantity. If we use X_1 to obtain a point on the long-run curve by holding X_2 constant, then only six years are required. In the relationship:

$$X_1 = a_0 + a_2X_2 + a_3X_3$$

the variables X_2 and X_3 become equal after X_2 has been held constant at a fixed level for six years. But, X_4 does not become constant until X_1 has been held constant for the period over which the long-run variable has been averaged. We are not necessarily interested in X_4 as such, but only in X_1 when it has become stabilized. Hence, X_1 can be used to trace out the long-run demand curve by holding X_2 constant at different levels for intervals determined by the definition of the long-run variable. Care must be taken to indicate when X_1 (i.e., the market price) under these conditions is the short-run price and when it is the long-run equilibrium price.

This illustrates a point of major importance in Working's analysis. Whereas the long-run quantities and prices used in the analysis are averages of short-run prices and quantities and hence are not long-run equilibrium prices, the relationship between such variables does display the long-run equilibrium conditions if correctly interpreted.

Additional variables can be used to show when X_1 is on the long-run demand curve. Since this occurs when X_2 and X_3 are equal we have for a linear demand curve:

$$X_1 = a_0 + (a_2 + a_3)X_3 + a_2X_5$$

where $X_5 = X_2 - X_3$. For a demand curve which is linear in logarithms we can set X_5 equal to $\frac{X_2}{X_3}$. If X_5 for the linear demand curve is set at some value other than zero or at some value other than one for the constant elasticity demand curve, we have a pseudo long-run demand curve. This curve differs from the true long-run demand curve only by a constant as determined by the value of X_5.

Rewriting the first equation discussed by Kuznets to agree with the symbols we are using we have:[3]

(1) $\log X_1 = -1.051 \log X_3 - 1.295 \log X_5 + \text{other terms}$

(1a) $\log X_1 = 0.244 \log X_3 - 1.295 \log X_2 + \text{other terms}$

The two equations, (1) and (1a), contain the same information since $\frac{X_2}{X_3} \times 100$ has been substituted for X_5 in equation (1) to get equation (1a).

Both Kuznets and O'Regan insist that the regression coefficient for log X_3 (the long-run quantity) on the current price, namely, log X_1 is the long-run price elasticity.[4] This is given by equation (1a), but not by equation (1). Holding X_3 constant in equation (1a), we have the short-run demand curve. Hence, the estimated parameter 0.244 indicates the manner in which the short-run demand curve shifts if the long-run quantity consumed were to change. Kuznets and O'Regan are mistaken in their concept of long-run elasticity since they do not consider the long-run price. Working maintains that the long-run price elasticity is -1.051, the estimated parameter attached to log X_3 in equation (1).

Since in our notation $a_2 = -1.295$ and $a_3 = 0.244$, Working is correct in stating that the long-run price elasticity is equal to $a_2 + a_3 = -1.051$. The fact that a_3 is positive shows that the estimates obtained agree with our economic theory which maintains that the price elasticity should be greater in the long run.

Kuznets also converts equation (2) into (2a):

(2) $\log X_2 = 1.118 \log X_7 + 0.548 \log X_8 + \text{other terms}$

(2a) $\log X_2 = 0.570 \log X_7 + 0.548 \log X_6 + \text{other terms}$

Where:

X_2 is current year's consumption of meat

X_7 is average of disposable income for the preceding ten years not including the current year.

X_8 is $\frac{X_6}{X_7} \times 100$

X_6 is given year's income.

Again, Kuznets insists that the coefficient attached to the long-run variable which merely shifts the short-run relationship is the long-run income elasticity. Again, one of the long-run variables is missing from the equations. The missing long-run variable is determined only when the

[3] *Op. cit.*, p. 887.

[4] In O'Regan's notation, $b_1 = -1.051$, $b_2 = -1.295$ and $b_1 - b_2 = 0.244$. O'Regan suggests that $b_1 - b_2$ is the long-run price elasticity. *Op. cit.*, p. 754.

other long-run variable and its short-run counterpart are equal (i.e., the short-run variable has been constant for a long enough period of time to stabilize the long-run variable). The long-run quantity consumed shows up only when X_6 and X_7 are equal. This means that a long-run relationship exists only when X_8 is equal to 100. Thus, setting X_8 equal to 100 in equation (2) gives us a long-run relationship. The regression coefficient for log X_7 in equation (2a) is not an elasticity, but simply a shift coefficient for a short-run relationship. In other words, the coefficients 0.548 and 0.570 in equation (2a) are added together to get the coefficient 1.118 in equation (2) and 1.118 is the long-run income elasticity. This Working has done.

This formulation of long-run and short-run demand used by Working makes use of the fact that the long- and short-run relationships are not independent. Given the effect of any two variables upon a third, the relationship of the fourth to any other is determined. In fact, the values of the long-run variables at any point in time are not independent of the path taken by the short-run variables in reaching that point. Thus, analysis of long-run demand is essentially a phase of dynamic analysis. Economists can perhaps give more empirical content to the Marshallian concept of long-run demand when the interrelationship between the short-run and long-run is fully realized and used to advantage.

INCOME AND HOME USE OF DAIRY PRODUCTS

DOROTHY DICKINS*
Mississippi State College

WHAT kind of income is best to use in studying the relationship of income to consumption of dairy products in the home?[1] This was a question asked recently in connection with a marketing study of dairy products including 403 families in two small cities and two villages of Mississippi.[2] Only six of these families had home-produced milk. This means that practically all depended on purchase for dairy products.

Three types of income were available for use for each of the 403

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[1] A study of family consumption of dairy products at and away from home is not feasible. It is impossible to obtain amounts of dairy products in prepared dishes eaten away from home. (In a previous study, "Dairy Products Consumption and the Market," Miss. Agr. Exp. Sta. Bull. 542, April 1956, it was found that only about one half of the dairy products used at home was in the form of fluid milk used in drinking.) Furthermore, the homemaker can furnish only limited data on fluid milk drunk away from home by family members.

[2] This study was a subproject of the Southern Food Marketing Study, SM-13.

families. These were: (1) Family income during the year preceding the interview. This income included the sum of wages and salaries, non-farm business and farm operation receipts minus business and farm expenses and all other income except non-recurrent income such as inheritances; (2) Per capita income (economic family size). To get this income the number of weeks in which each person had been a member of the economic family during the year preceding the interview was totaled and this total divided by 52 (weeks in the year). Family income divided by economic family size gave per capita income (economic family size). (3) Per capita income (meal family size). To get this income the total number of meals eaten from the home food supply during the report week was divided by 21 (number of meals in one week). Family income divided by meal family size gave per capita income (meal family size).

Three types of consumption data for dairy products were available for these analyses. These types were: (1) Quarts of fluid milk (sweet, chocolate, and buttermilk) used per capita per family during the report week. (2) Quarts of fluid milk equivalent (fluid milk plus the fluid equivalent of evaporated, condensed, and dry milk, cream, ice cream, and cheese on the basis of protein and calcium content) used per capita per family during the report week. (3) The percentage of the recommended amounts of milk products used by each family during the report week. Recommended amounts were amounts of dairy products recommended for one week in low-cost food plans by specialists in the Home Economics Research Branch of the USDA for families of similar size and composition.[3]

The per capita consumption of fluid milk and of dairy products was calculated by dividing the total quarts of fluid milk and quarts of equivalent milk used at home by the number of members fed from the home supply during the study week. The number of members fed from the home supply was obtained by dividing the total number of meals eaten at home during the report week by 21 (number of meals in one week). Recommended amounts were also based on recommendations of dairy products for the number of meals taken for each of the persons taking meals.

Table 1 gives average income and consumption for the White and Negro families included. The median income of the 232 White families was $4,000; of the 171 Negro families, $1,320.

In Table 2 is shown the correlation coefficients and regression coefficient with 5% confidence limits for the three types of income and of consumption of milk products. No significant relationship was found in family income and the use of milk and its products. This was because the num-

[3] *Rural Family Living*, March 1955, Home Economics Research Branch, Agri. Research Service, USDA, p. 10.

TABLE 1. AVERAGE TOTAL INCOME, PER CAPITA INCOME (ECONOMIC FAMILY SIZE), AND PER CAPITA INCOME (MEAL FAMILY SIZE) 1953–54 AND MEAN QUARTS FLUID MILK PER CAPITA, QUARTS FLUID MILK EQUIVALENT AND PRECENT OF RECOMMENDED AMOUNTS DAIRY PRODUCTS USED DURING REPORT WEEK, NOVEMBER, DECEMBER, 1954, OF 232 WHITE AND 171 NEGRO FAMILIES IN TWO EACH OF MISSISSIPPI SMALL CITIES AND VILLAGES

Item	White families (232)	Negro families (171)
Income		
Total income	$4,156	$1,537
Per capita income (economic family size)	$1,404	$ 505
Per capita income (meal family size)	$1,429	$ 535
Consumption		
Quarts fluid milk per capita	3.4	1.9
Quartz fluid milk equivalent per capita	4.8	3.1
Percent of recommended amounts dairy products	119	78

TABLE 2. CORRELATION COEFFICIENTS AND REGRESSION COEFFICIENTS WITH 5% CONFIDENCE LIMITS FOR THREE TYPES OF INCOMES (1953–54) AND MILK PRODUCTS CONSUMPTION, REPORT WEEK, NOVEMBER, DECEMBER, 1954, OF 403 FAMILIES IN MISSISSIPPI INCLUDING 232 WHITE FAMILIES AND 171 NEGRO FAMILIES

Race and milk products		Family income		Per capita income economic family size		Per capita income meal family size	
		r	b	r	b	r	b
White families							
Quarts fluid milk per capita	Lower limit	−.114	−.000118	−.084	−.000210	.018	.000045
	Estimate	.015	.000015	.045	.000110	.147*	.000367*
	Upper limit	.144	.000148	.173	.000430	.271	.000689
Quarts fluid milk equivalent per capita	Lower limit	−.123	−.000145	−.058	.000165	.027	.000079
	Estimate	.006	.000007	.072	.000201	.156*	.000446*
	Upper limit	.135	.000159	.199	.000327	.279	.000813
Percent of recommended amts. dairy products	Lower limit	−.123	−.004176	.026	.01044	.101	.00761
	Estimate	.006	−.000188	.155*	.01139*	.228**	.01709**
	Upper limit	.135	.003800	.278	.01234	.346	.02657
Negro families							
Quarts fluid milk per capita	Lower limit	−.048	−.00008	.090	.00036	.128	.00040
	Estimate	.103	.00016	.237**	.00095**	.273**	.00085**
	Upper limit	.249	.00040	.374	.00154	.406	.00130
Quarts fluid milk equivalent per capita	Lower limit	−.077	.00018	.134	.00076	.164	.00072
	Estimate	.074	.00016	.279**	.00158**	.307**	.00135**
	Upper limit	.222	.00050	.411	.00240	.437	.00198
Percent of recommended amts. dairy products	Lower limit	−.112	−.00536	.185	.04904	.204	.02558
	Estimate	.039	.00395	.327**	.05129**	.352**	.04288**
	Upper limit	.188	.01326	.454	.05354	.469	.06018

* Significant at the 5% level.
** Significant at the 1% level.

ber of family members is a more important factor in consumption of dairy products than is family income.[4]

There was, however, a significant relationship in per capita income and the use of milk products (Table 2). This relationship was closer for Negro than for white families due, no doubt, to the fact that the level of income for Negro families was much lower than for white famiiles. (See Table 1).

The relationship was closer when per capita income was figured on meal family size than economic family size. This might be expected since amounts of fluid milk and of fluid-milk equivalent per capita and the percentage of recommended amounts of dairy products were based upon the people fed from the home supply during the report week. Economic family size was historical in that it was a record of members dependent on the income during the past year. The number of members fed during a particular week would differ from the number dependent on family income during the past year, being either smaller or larger. For 28 percent of the white families and 51 percent of the Negro families economic family size and meal family size was the same. In other words, which figure on family size was used mattered less in the case of Negro families than in the case of white families.

From these data it would seem that in studying relationships in income and milk products consumed at home that per capita income figured on the meal-family size basis might be used. The number of meals served from the family food supply during the past week is a kind of information much more quickly and accurately obtained from the homemaker than is the number of members in the economic family during the past year.

[4] *Dairy Products Consumption and the Market*, Miss. Agri. Expt. Sta. Bull. 542, April 1956. Pp. 20-21.

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REVIEWS

Federal Farm Law Manual, Allan E. Korpela. Orford, New Hampshire: Equity Publishing Corp., 1956. Pp. xi, 698.

The book *Federal Farm Law Manual* by Allan E. Korpela is a reference work. Most of the material included is of the type to be studied in search of an answer to a particular problem rather than read for general background or entertainment. One would be no more apt to read this volume from cover to cover than he would be inclined to curl up for an evening with a copy of the *United States Code*. Sections of this book, however, will be of interest to all who are concerned with the problems of the farmer or who operate closely with him.

The book is divided into eight major topics: (1) Administration, (2) Stabilization, (3) Marketing and Processing, (4) Conservation, (5) Credit, (6) Health, (7) Taxation, (8) Education, Research and Special Services. Under each of these topics is reported in paraphrased form the applicable acts of Congress and the admiinstrators' rulings. For example, the material under Stabilization discusses the several agricultural adjustment acts enacted by Congress, the creation and operation of the Commodity Credit Corporation and the Commodity Stabilization Service, regulations controlling marketing quotas and acreage liimtations, legislation on tariffs and trade agreements, and the Federal Crop Insurance Act.

The background and explanatory material, introducing and supplementing the reports on the laws and regulations, is of further real interest and value. The section on stabilization, for example, includes an explanation of the meaning of "parity," a history of government price support programs, and a report of policy approaches that have been followed in controlling production problems. The author has made his most substantial contributions through such sections.

An appraisal of the value of this work to members of the various classes of potential readers will explain my views as to its usefulness.

Teachers and students of farm law and agricultural economics. Surely this volume provides a convenient source of information for any teacher who works with the subject matter listed in the Table of Contents. The growing popularity of courses in farm law has increased the number of teachers who need familiarity with the many federal laws and regulations applicable to farmers. Also, those teaching most courses in agricultural economics have occasion frequently to study the effect of federal laws on prices, production, and marketing of farm products. This manual answers the need of these teachers.

As a teaching tool to be distributed to students, the adequacy of this volume can be questioned with sound reason. It should be available for

reference and, if the copy-student ratio permits, selected readings can be assigned profitably for study. However, Beuscher's *Law and the Farmer* is a more readable and fundamental text for a farm law course. Such a course cannot be limited to federal law. Similarly, no course in agricultural economics will find this *Federal Farm Law Manual* adequate as a basic text. It was not prepared for that purpose and is too narrow in scope. It would provide an excellent "second text" for those affording this luxury.

Agricultural agents. Anyone who is an adviser of farmers, particularly agricultural agents, will have many occasions to use this volume for learning or refreshing himself as to the effect of federal laws and regulations in any of a great many situations. A man having such a status cannot always seek professional assistance in finding answers to the variety of questions given him. Once he becomes familiar with the contents of this volume, he should be able to determine with sufficient accuracy the approach taken by the various federal controls. Although this book provides many specific answers, the farmer adviser who is not trained in studying and interpreting legislation should not attempt to brief answers to specific questions and give legal advice upon which the troubled farmer will rely. He should be equipped to recognize legal problems, however, and to alert farmers to their need for a lawyer's advice.

Farmers. Most farmers would find the reading of this volume a chore toward which they would soon develop a strong reluctance, unless they are expert at reading only selected paragraphs. On each subject there is much included that would not be of practical concern to the farmer.

Anyone who has attempted to paraphrase statutory material in a manner that makes it easily understandable and yet accurate knows how very nearly impossible it is to accomplish these goals. Mr. Korpela undertook this job. He did very well but, for the sake of accuracy and completeness, he felt required to include much that is irrelevant detail to most readers. For example, on page 169 at the closing of the chapter on the Commodity Credit Corporation is one section which I quote in its entirety. "Oral presentations are stenographically reported and transcriptions are made when deemed necessary by the board. One copy of the transcription is made available to the petitioner upon request." This example of detail is not an isolated one. It doesn't take many such encounters for a farmer's mind to rebel.

A strong argument in favor of making this book available to farmers is that the subject matter included has not been developed in the bulletins which typically are the medium for explaining to farmers their rights and duties and suggesting a course of action to them. Even so, this book is neither as readable nor as understandable by the farmer as are such bulletins. The need then is for the development of bulletins from the ma-

terial contained in this volume rather than to rely on this manual to satisfy the farmer's need. This manual will be a substantial assist to such development.

Lawyers. Can the lawyer who is charged with the professional obligation of advising farmer clients obtain from this book the knowledge of federal farm laws required of him? The answer depends upon the function being performed by the lawyer. If he is in need of a general understanding of a particular area of federal controls, a reading of this book will prepare him adequately and, indeed, is an excellent tool for such preparation. More general knowledge can be obtained in a shorter time from a reading of this book than from a study of the source materials. The author provides background discussion, states an explanation of related facts, and ties together a paraphrase of legislation and of regulations in a manner that makes possible a quick grasp of the purpose and effect of federal activities described.

Any lawyer who is required to give specific advice on which a farmer-client is to rely and act, however, must go further than the contents of this book. He must study the United States Code directly, rather than relying on a paraphrase, and check all applicable administrative rulings. In addition, he must brief the related court decisions. There are very few references to court decisions throughout this book. To base his advice on anything less than a direct check of the source is to risk an inaccurate interpretation. Inevitably, some variation of meaning results from a paraphrase.

Thus, a lawyer will profit in time and knowledge by using this book as a starting point for developing his knowledge in this area of federal law, but he will be required to study further as specific problems arise.

It may appear incongruous for me to suggest that his book is too detailed to serve the purposes of some readers and to follow this with the statement that the lawyer dare not rely upon the material here presented because of his need for assurance of absolute accuracy. I believe there is no inconsistency in this because of the differing needs of the different classes of readers.

The author has done a remarkable job of bringing the material up to date as of the date of publication. The nature of the contents makes this task difficult. The need for being up to date is a continuing problem and one that cannot be handled with complete satisfaction by pocket supplements, as are planned. Such supplements lag too far behind the changes they report. This lag may not be serious to the lay reader but it is a real concern to the lawyer. Since there is no better practical answer available in a situation such as this, Mr. Korpela deserves only praise for doing as well as possible.

An example of the problems encountered as to timeliness and com-

pleteness will be found in the chapter on Social Security. Section 23 of Chapter 31 discusses one aspect of obtaining coverage for a self-employed farmer. It states that "Income from share-farming may be included only if there is material participation by the owner or tenant in the production by the share-farmer, or in the management of the work, and in the product." Korpela is to be commended for including this statement, which is very recent law, in this book. However, since the publication of the book the Social Security Administration has been working on the meaning of the phrase "material participation." Without that definition, it is impossible for anyone to understand the effect of this provision of the Social Security Act. The Social Security Administration has developed some rather specific tests to apply in order to assist a farmer in determining whether or not he is materially participating. These tests are not included in this book and could not have been included because they were not known at the time this book was published. The farmer, the lawyer, and others concerned with this problem, however, will look to those tests for guidance in order to avoid dispute with the Social Security Administration. A loose-leaf service is the only effective method for meeting this problem and it is too expensive for this type of publication.

In concluding, I must make it clear that as a teacher of a course in farm law which is offered to College of Agriculture students, and because of my frequent exposure to farmer queries on a wide variety of subjects, I am deeply appreciative of the work that Mr. Korpela has done in producing this manual. His work will enable me to have a satisfactory understanding of many fields of federal farm law which otherwise I would not have found time to study thoroughly for myself. The efforts he devoted to the careful preparation of this volume have been a time-saving help to me.

AUGUST G. ECKHARDT

University of Wisconsin

The Agricultural Commodity Programs: Two Decades of Experience, Murray R. Benedict and Oscar C. Stine. New York: The Twentieth Century Fund, 1956. Pp. xii, 510. $5.00.

This is the last of three books prepared largely by Professor Benedict and financed by the Twentieth Century Fund. The first, "Farm Policies of the United States: 1790-1950," reviewed in this *Journal*, Vol. XXXV, Nov. 1953, p. 637, is surely a landmark in the field. The second, "Can We Solve the Farm Problem?", reviewed in this *Journal*, Vol. XXXVIII, Aug. 1956, p. 878, led the reviewer to indict agricultural economists for adopting economic principles and attitudes which, on matters of farm policy,

have reduced the once-influential profession of agricultural economics to the role of neglected scolds.

August Heckscher, Director of the Fund, starts this volume off auspiciously with a foreword which includes the statements: "There has obviously been demagogy and special pleading in connection with the farmers case. . . . The shaping of farm policy is a laboratory in which mutual adjustment of economic compulsions and basic values can profitably be studied."

An excellent feature of this volume is its comprehensive 28-page introduction and summary. Many readers will content themselves with reading only this section. But anyone who has questions about the detailed operation of a commodity program will find them answered in one of the eleven chapters.

If he has questions on synthetic fiber and foreign production of cotton as related to the cotton program, he will find the answers on pages 43 and 44. He will find the effects of the processing tax on tobacco reported on page 64. If interested in the wheat program in 1936 see page 107. Such a listing could go on indenfiitely.

Perhaps the greatest merit of this volume is that it records in great detail the facts relating to each of these commodity programs from their beginnings in the early 1930's to the present time. Some chapters are better than others in respect to the analysis and interpretation of the historical facts presented. The chapter on cotton is especially good in this respect.

The authors' over-all conclusions, from their study of these commodity programs, appear to be that "The time seems now to have arrived for devising more carefully considered and specialized programs designed to meet the needs of farmers, and of the general public under a different set of conditions [than the depression of the 1930's or the World War II period]" (p. xli). Congress should delegate more responsibility to the executive branch, for administrative management, or to a regulatory commission. And, . . . "the problem is that of somehow channeling into agriculture a reasonably adequate share of the total national income without at the same time maintaining it as an overexpanded and relatively inefficient part of the economy. . . . We must be willing to abandon traditional patterns where that is logical and to continue and strengthen those types of activity that are suited to present-day conditions, or to devise new ones if necessary" (p. xliii).

These are bold sentences; but the authors stopped at this point. The volume appears to be more Benedict than Stine. The reader interested in lessons to be learned from the past may want also to read Stine's paper

"Mistakes and Lessons in Agricultural Economics in the Last 25 Years," published in the 1954 proceedings issue of this *Journal*, Vol. XXXVI, Dec. 1954, p. 806.

In contrast to the conclusions of the authors quoted above that the problem is one of somehow channeling a reasonably adequate share of the national income into agriculture without at the same time maintaining it as an overexpanded and *relatively inefficient* industry, Dr. Stine in this earlier paper included a section under the heading "Controls Contribute to Efficiency and Conservation." In this section he reported that Gale Johnson, Earl Heady and Murray Benedict, although looking for evidence of inefficiency as a result of government price support and adjustment programs, on balance found the opposite. In Stine's words (p. 814), "These economists are 'agin' monoply and regretfully admit that the results to date are more acceptable than expected . . . the control programs to date have contributed to readjustments with some increase in total production."

WALTER W. WILCOX

Library of Congress

Agriculture and Industry Relative Income, J. R. Bellerby. London: Macmillan and Co., Ltd., 1956, Pp. xii, 369. $6.75.

Agricultural economists in the United States are familiar with the problem of comparing average incomes of farm and nonfarm people. In years that were relatively prosperous for the nonfarm economy, USDA estimates indicate that per capita incomes of farm residents from all sources have averaged only about half as large as those of nonfarm people. The comparison is sometimes quoted with an implication that government should immediately set about to raise the farm figure to equality with its nonfarm counterpart through price supports and income payments. In contrast, most economists would argue that the official comparison is far too gross to serve as a basis for policy.

To refine this comparison, economists have suggested the evaluation of home-produced food at retail prices, the adjustment of imputed rental values of farm housing to something like urban levels, a correction for the greater number of dependents per worker in the farm population, and an allowance for the concentration of farm people in regions where nonfarm incomes are below the national average. Such adjustments eliminate a sizeable fraction of the apparent disparity; another large fraction would be eliminated if output per man-hour in Southern agriculture could be raised to the level realized in the North and West. However, under 1955-56 conditions the adjusted ratio of farm to nonfarm incomes would still be considerably less than one.

Enough has been said to suggest the difficulties of measuring and interpreting farm-nonfarm income relationships. Bellerby has set himself the ambitious task of measuring the ratio of "incentive incomes" of farm operators to those of nonfarm people for a number of countries and of explaining the ratios observed. ("Incentive income" is the return to labor and management.) His leading theoretical concept is the "supply price of agricultural enterprise." The general supply price of agricultural enterprise is defined as that average rate of incentive income per head for which farmers as a group will make available a given net product. Some graphic illustrations of this concept suggest that, in the United Kingdom, the great majority of established farmers would continue farming at a labor and management return less than half of the average for nonfarm workers; that most farmers' sons would remain in farming at incomes 50 to 80 percent of the nonfarm average; that entrants into farming from other occupations might be attracted by incomes 60 to 90 percent of the nonfarm average.

Fully half of the book is devoted to a presentation of estimates of farm and nonfarm incomes in different countries. There are attempts to allow for differences in retail prices of consumer's goods to farm and nonfarm residents in the various countries, and comparisons of farm wage rates with industrial wage rates in some of them. These sections were written by seven different authors and, despite Mr. Bellerby's efforts to maintain focus and continuity, the book as a whole is rather loosely put together. Bellerby reports "incentive income ratios" (farm divided by nonfarm) for 28 different countries ranging, as of 1938, from less than 35 percent to more than 75 percent. Practically all of the advanced industrial countries showed incentive income ratios of less than 70 percent. The average of the whole group of countries of this type for the period 1933-38 was estimated at about 55 percent. "There is thus an income disparity of 45 percent, the causes of which are to be defined and ranked if possible in order of importance."

Bellerby lists the following causes as determining the farmer's individual supply price: "(1) Occupational immobility, associated with mobility inwards; (2) social immobility; (3) personal immobility and inertia; and (4) psychic attractions, including the security arising from self supply, and cheapness of living due to conditions other than low retail prices." He concludes that occupational immobility ranks first in importance and that, *if acting independently* in the conditions before 1939, it "would probably have been capable of producing a disparity of 30-35 percent of the nonfarm average incentive income in most countries. . . . Psychic attractions of all kinds . . . could not independently account for a disparity of more than 20 percent. . . . Personal immobility . . . was

capable of causing an appreciable disparity in the older countries, though it had little significance in the New World, at least among the all important marginal groups contemplating migration. . . . Social immobility seems to have been of minor importance everywhere."

Bellerby goes on to consider the prospective levels of the supply price of agricultural enterprise in industrial countries under conditions of prosperity and depression respectively in the long-term future. In prosperity, he concludes that "if 55 percent may be accepted as a fair estimate of the prewar world average incentive income ratio, 75 percent is as high a figure as can reasonably be expected to emerge in the long-term future in conditions most favorable to agriculture. Implicit in this statement is the assumption that public measures will be neither greater nor less in scope than they were before 1939." Under depressed conditions the incentive income ratio averaged for the world as a whole would drop below 60 percent.

To prevent a renewed persistent decline in the incentive income ratio during the years ahead Bellerby stresses (1) avoidance of world depression; (2) avoidance of the accumulation of world stocks of agricultural products; (3) increased occupational mobility of members of farm families; and (4) development of agriculture as a profession. The last of these points will seem novel and in part objectionable to readers in the United States: "In the interests of agriculture, a measure ranking equally with the education of farmers' sons for nonfarm work is the establishment of a corresponding scheme of education for farming. . . . The ultimate purpose is to provide comprehensive arrangements so that admittance to agriculture may be through the channel of recognized training. In short, it is desirable that agriculture should become a profession in the fullest meaning of the term. . . . From the social point of view there is no more important function of a farmers' organization than to make a professional study of the requirements of agricultural efficiency, then to consider what methods of training will give the experience and skill needed, and finally to suggest the nature of the tests and evidence which should precede qualification. . . To what extent and at what stage the tests are in fact applied to give title to entry is a matter for decision partly by agricultural and landowning interests and partly by public authorities when they give their recognition."

The uneven pacing of this eight-author book has already been noted. The statistical materials for many countries are extremely rough and I would guess that errors of 20 percent or more in the estimates of incentive income ratios may well occur quite apart from the problems of interpretation that arise in a country as diverse as the United States. Nevertheless, the book provides a point of departure for much interesting speculation. How important are the various causes of income disparity in different

parts of the United States? Under what conditions can full equality of labor-management returns in agriculture and industry be expected? If such equality appears to be a realistic goal in the vicinity of large metropolitan labor markets, is it a realistic goal for the Corn Belt, the Great Plains, or the Southeast? Will the practical upper limits of the income incentive ratio differ among regions for 10, 20 or even 30 years ahead? Can we arrive at norms for public policy in the different geographical situations and realistic time-tables for the improvement of farm relative to nonfarm incomes? What would be the effects of specified programs for raising farm incomes in the different situations?

Bellerby does not answer such questions or even raise them in such specific forms. But his book warrants at least a cursory inspection by all economists who are interested in farm income policy and the problems of adjusting agriculture to economic growth.

KARL A. FOX

Iowa State College

The Agricultural Implement Industry in Canada, W. G. Phillips. Toronto: University of Toronto Press, 1956, Pp. xi, 208.

The book is one of a series entitled *Canadian Studies in Economic* sponsored by the Canadian Social Science Research Council. The preface states that this is a study that traces the development of the Canadian agricultural implement industry and examines some aspects of competition. This claim is a modest one because in addition to a thorough analysis of competition in the industry the study provides an excellent description of its development in both Canada and the United States. The results of the study are clearly presented and well documented (there are 29 pages of footnotes).

The rapid introduction of machinery into agriculture has raised problems of technical management, of finance and increased vulnerability to changing cost-price relationships. Associated with these problems has been the need to adjust the farm business to make effective use of machines. Thus farmers have often found that a machine that they regard as essential appears to be excessively high priced. These conditions have aroused in farmers' minds suspicions of collusion in pricing and have had political overtones. Also contributing to a complex pricing situation has been a rapidly changing machine technology and a market that has been unpredictable and widely dispersed geographically.

The book is divided into three parts. Part One describes the growth of American industry. The author begins with the invention of the reaper and goes on to relate the story of the struggles on patent rights prior to 1890 with C. H. McCormick as the central figure. This was followed by a period of cut-throat sales competition and this was followed by a series

of mergers that reduced the number of manufacturers to seven. The author portrays this latter process in an excellent chart in Chapter 1. The next important stage was a long period of investigation by the Bureau of Corporations into the extent to which International Harvester was responsible for lack of competition in the industry. This part ends with a chapter describing the tractor revolution since 1915.

The Canadian industry is examined in Part Two and the contrasts between the United States and Canadian counterparts are well brought out. In Canada the history is quite different. There was no period of patent wars; the effect of the tractor revolution was less severe because the source of tractors was via imports from the United States; and the problem of lack of competition in pricing has not been subject to formal investigation and litigation. But the author shows how the instability of Prairie agriculture has affected the industry, how the struggle for tariff protection was lost and how the industry has matured without protection to the point where most of the farm implements produced in Canada are exported and most of those used are imported.

Part Three, entitled "Competition," contains the economic meat of the study. One could hardly select a more interesting industry for research in this area. There has been leadership not by a single firm but by individual products. Leadership has thus been distributed among firms. Price policy has been influenced by political considerations. The firms have had little help from costs in determining prices because of the fluctuations in sales associated with the variable income of prairie agriculture. Furthermore, the systems of distribution and credit extension have been most elaborate. The author assesses all of these factors to answer the question: What sort of competition has prevailed in the industry?

His conclusions are as follows: Price competition has been inactive in the history of the industry but nonprice competition in the areas of distribution and credit extension has been highly active. The wasteful methods in distribution have been partly removed since 1945 and the costly credit system has been improved partly through the provision of short-term credit by government under the Farm Improvement Loans Act.

This book is a valuable contribution because in addition to its scholarly qualities the author is convincingly objective. This detachment is essential because the evidence is replete with the statements of industry spokesmen and its critics. The book is hard to read because of the small type used and this shortcoming is unfortunate because of the high quality of the work on the part of the author.

W. J. ANDERSON

University of British Columbia

V for Vinoba, B. R. Misra. Bombay-Calcutta-Madras: Orient Longmans, 1956. Pp. vi, 67. Rs. 3 ($.60).

Like most Indian ventures in biography, "*V for Vinoba*" does not measure up to Western standards for this particular form of literary expression. The author feels that he has fulfilled his obligations by giving a formal and cursory factual account of the life of Acharya Vinoba Bhave with occasional side glances at his agrarian reform program. We learn that Bhave was born on September 11, 1895 to high caste (Brahmin) parents; that he dropped out of college in 1916 before earning his degree and became a follower of Mahatma Gandhi. We lose track of him until 1951, although we are told that Bhave was closely associated with the Gandhi program for the removal of untouchable and for the development of a handicraft economy to counter the growth of Western-style industrialism. The biographical material comes to a focus in Bhave's organization of the Boodan movement on April 18, 1951 which proposes to achieve land redistribution by persuading owners to give one sixth of their acres to the poor. Dr. Misra notes that Vinoba built his unusual agrarian program on the principle of non-violence to counteract the Communists in Hyderabad State who agitated for land redistribution by revolution. He also tells us that Vinoba's target was the donation of 50 million acres of land and that he had induced land lords to give up 3,758,692 acres by 1955.

The personal material on Vinoba's life is too scanty to enable the reader to understand the sources of his moral strength and the character traits that enable him to persuade landlords to part with their land. Nothing is said about the qualities of leadership that have brought Vinoba a band of devoted disciples. Misra tells us he is a saint, but leaves us uncertain about the qualities of sainthood that dominate his personality. The reader is also left in the dark about the exhausting daily routine of Vinoba and his followers as they pursue their work.

The achievements of the Boodan movement up to this point are also dealt with rather uncritically. The author neglects to inform us about the rather formidable problems that have slowed down the actual transfer of land gifts to the peasants. He also refrains from comment on the often repeated charge that donors have given away considerable acreage poorly suited to cultivation.

A venerable religious tradition has discouraged Indians from preoccupation with the self and hence from the creation of a biographical literature rich in personal details. If all of the limitations of *V for Vinoba* could be attributed to Misra's background, he would merit restrained treatment from the reviewer. Unfortunately the author is primarily interested in using Vinoba as a vehicle for his own ideas. Misra strongly indorses socialism and collective ownership of land. Much of the book is devoted to

his arguments about this issue. He tells us on page 33 that the collectivizing of Indian agriculture "is a historical necessity from which there is no escape." Vinoba does not want a planned economy, but—as the author says—a village state (page 56). He quotes Vinoba as saying that the goal of Boodan is a stage "when authority in every form will have become unnecessary and will, therefore, fade away, giving rise to a perfectly free society." Obviously this Indian version of Utopian socialism is something quite different from the collective form of economy envisaged by Misra. Although Misra does not say so, it is clair that he would favor a mechanized agricultural system at mortal odds with the handicraft system idealized by Vinoba. The author also avoids facing up to the likelihood that Indian villagers would have to be coerced into joining collectives.

Misra does not deserve criticism for advocating an Asiatic variant of Marxian socialism, but for confusing it with Vinoba's religious and Utopian socialism. The author has included so many accurate quotations of Vinoba's position that the reader might think Misra had confused it with his own views through ignorance. It is more likely that the author wants to have his cake and eat it. With the curious blindness of the educated Indian, he would like to believe that it is possible to achieve a full-fledged socialist society without violence. Because Vinoba advocates a peaceful type of agrarian reform, Misra hails it as a temporary tactic for hastening the advent of the very different society that he wants. His propagandistic approach mars the objectivity and usefulness of the book. We can only gasp at his assertion on page 1 that India emerged from British control by nonviolence when more than 5,000,000 were killed in the partition riots in 1948. This and other sweeping generalizations should caution the reader to pick his way through Misra's book with care.

G. H. MAYER

Purdue University

The New Revolution in Cotton Economy, James H. Street. Chapel Hill: The University of North Carolina Press, 1957. Pp. xvi, 294. $5.00.

Dr. Street is concerned with complete mechanization of cotton production. In order to show the importance of this technological change, he covers the history of cotton production from its beginning in the United States to the present day. In the preface of his book he states that he sought the answers to two questions: "Why has a rapid acceleration recently begun in the improvement of American methods of cotton production?" . . . "And why did it take so long?" He is concerned as much with the delay in this technical development as he is with the explanation of the change.

The book is divided into three sections. The first section deals with the

history and development of social, economic, and political institutions surrounding cotton production in the United States from the late 18th Century to the present date. Street restates the proposition made by many students of the ante-bellum period—that cotton production was the motivating force that caused the rapid increase of slaves in the South. His opinion is that the plantation system of the South is very similiar to colonial economies. This ante-bellum colonial type of economy carried over into the post Civil War period. Although the slaves were free, the share-cropper system and the financial institutions—for all practical purposes—were clearly colonial. The major institutions influencing this type of agriculture in the South until World War II, were the financial and credit institutions. World War II created enough "pull" force in the population to encourage shifts from the southern states to the industrial areas of the North and West. This "pull" force continued to increase after World War II, and helped the removal of large supplies of underemployed people from the South to the North and West where they could be more fully employed.

The second section of Street's book covers the development of mechanical harvesters, both strippers and spindle-type pickers, as well as other machines used in mechanized cotton production. A long period was needed for developing the mechanical harvester because the machine had to be completely designed and the inventors could not rely upon previous innovations. If cotton production is to be completely mechanized, there is a need for machines to thin and cultivate the cotton, in addition to harvesting. If it is necessary to hire hand labor to thin and hoe cotton, this labor will also be available to harvest cotton. And, in most instances this labor is not fully employed throughout the year.

Street gives two reasons for the rapid increase of mechanical harvesting during and after World War II: (1) Production of cotton increased in the West more rapidly than the supply of labor increased. (2) Some cotton producers purchased mechanical harvesters and left them in the sheds to insure themselves of having a method of picking cotton in the event there was a labor shortage.

In the third section of his book, Street explores the social consequences of mechanization. He feels that the opportunity for off-farm employment has had a greater influence in causing the underemployed labor of the South to move into industrial areas, than the technical advancement of the mechanical harvester. After examining the development of mechanical harvesting in the West, Street concludes that mechanization of cotton production is feasible. He points out, however, that as far as the Old South is concerned, social institutions tend to retard this development.

The reviewer gets the impression, from the preface of the book, that

Street's primary objective is to show the results of mechanized harvesting. But, it becomes apparent that the author has made his greatest contribution in showing how political, social, and economic institutions can create a situation that promotes underemployment and in showing how this underemployment can be eliminated.

The author does not clearly state whether he thinks that mechanization is the force that will eliminate underemployment of human resources in the South or whether it will be the "pull" force of job opportunities in industrial areas that will eliminate this underemployment. Apparently he believes that the latter force will have the greater influence, although he believes that the shift of population from the rural South to the industrial areas will be facilitated by complete mechanization of cotton production.

The major criticism that the reviewer has of the book is that it is very detailed and often the reader is lost in the detail and is not able to see clearly the objectives of the book.

THOMAS M. STUBBLEFIELD

University of Arizona

On the Economic Nature of Cooperation, Paavo Kaarlehto. Uppsala: Almqvist & Wiksells Boktryckeri AB. 1956. Pp. III, 114. Reprinted from "Acta Agriculturae Scandinavica," VI: 4, Stockholm, 1956.

The author's purpose is stated in his forward as follows: "The striking need of a pure economic theory of cooperation has led the author to an examination . . . of what are believed to be the economic essentials of cooperation . . . the author hopes thus to contribute to the development of a consistent and reasonably realistic theory."

The subject is discussed in three chapters. The first is introductory, consisting of a brief but satisfactory review of literature and an outline of the method of approach used. The second includes 68 of the 95 pages of text in the book and presents an accurate picture of the modern microeconomic concept of the cooperative association. The third presents a very brief analysis of the behavior of the cooperative under pure competition, monopolistic competition, imperfect competition in marketing and imperfect competition in production. Statistics on Finnish cooperative stores and cooperative dairy marketing cooperatives are used to illustrate the economic concepts presented. The subject matter is presented in thesis style; the book is not indexed.

The book is well written and shows the author's familiarity with and understanding of modern economic theory of cooperation. It is primarily a review and synthesis of recent contributions, including the author's own

contribution in 1955,[1] rather than a major advancement in the theory. But it will serve as an important reference for graduate courses on cooperation at colleges and universities in the United States.

The review reader who has followed the recent contributions to the economic theory of cooperation in this *Journal* and elsewhere will be interested in some of the finer points presented by Kaarlehto in the book under review. He agrees with Emelianoff[2] and myself[3] that the cooperative is not a firm in the usual sense. But he does not recognize the cooperative as a jointly owned and jointly operated plant. Instead he broadens the usual concept of the firm and recognizes cooperatives as "non-independent firms" in contrast to "independent firms or enterprises." This appears only to be a matter of terminology—our concepts of the cooperative seem to be identical. However, he does not deal with the cooperative association as distinguished from the cooperative activity, even though he cites Robotka's earlier article which serves as the framework for this distinction.[4]

His equilibrium conditions for the individual participating firms are developed on the basis of pooled average and marginal funcitons for the individual operations of these firms. They are derived from the average revenue and average cost functions faced in the cooperative, in the manner developed in his 1955 article.[5] These pooled functions require two assumptions, as the author states on page 89 "(1) that the output level in each member firm is optimal; (2) that the number of member firms is sufficient to utilize the capacity of the cooperative plant in the best possible way." Thus it appears that the author has assumed away the problem of simultaneous solution of equilibrium for the participating firms, and has not solved it after all, as the reader is led to believe.

But a more serious criticism can be made of this equilibrium analysis. His analysis, like my own,[6] falsely assumes that the cooperating firms act rationally as a group. Actually, as Aresvik[7] has correctly pointed out, they each make independent production decisions and therefore do not act rationally as a group. Although he cites the article, it appears that the

[1] P. Kaarlehto, "Cooperation as a Form of Economic Integration," *Acta. Agr. Scand.*, 5:85-97, 1955.

[2] Ivan V. Emelianoff, *Economic Theory of Cooperation*, the author: Washington, D.C., 1948.

[3] Richard Phillips, "Economic Nature of the Cooperative Association," *Journal of Farm Economics*, 35:74-87, 1953.

[4] Frank Robotka, "A Theory of Cooperation," *Journal of Farm Economics*, 29:94-114, 1947.

[5] P. Kaarlehto, *op. cit.*

[6] Phillips, *op. cit.*

[7] Oddvar Aresvik, "Comments on 'Economic Nature of the Cooperative Association,'" *Journal of Farm Economics*, 37:140-144, 1955.

author has completely overlooked Aresvik's one major contribution to the theory. Although Kaarlehto's analysis on the point is much more sound than that of Clark,[8] this oversight unfortunately leads him to erroneous conclusions as to the behavior of the cooperative under monopolistic competition and under imperfect competition in marketing. A similar analysis on the basis of the Aresvik contribution would show that many times a cooperative association would not (or perhaps better, could not) restrict output more than does a firm in the same situation.

RICHARD PHILLIPS

Iowa State College

Patterns of Farm Financial Structure, Donald C. Horton. Princeton: Princeton University Press for the National Bureau of Economic Research, 1957. Pp. xx, 185. $4.50.

If you have pondered how farm resources get financed, Dr. Horton's investigation provides an interesting basis for reflection. The author draws a number of guarded presumptions from census data and unpublished figures which he analyzses at the county level by means of cross tabulations.

In the absence of adequate data on individual farms, Horton selected 108 counties that he considered internally homogeneous with respect to type of farming and sufficiently diverse with respect to the sample as a whole to represent "widely different kinds of agriculture." Indicators of economic characteristics including farm resources used in the study were physical assets in land, buildings and non-real estate, proportion of land in crops, proportion of real estate in dwellings, farm product value, days of off-farm work, and change in physical asset value from 1930 to 1940. Investment in agricultural resources were classified under operator, landlord and creditor interests.

The study proceeds by a series of cross-classification investigations, first by one indicator, then by breaking the resulting groups into several smaller groups according to the values of the second indicator, and averaging for each subgroup values of the various indicators. Horton readily admits that the findings are limited by the nature of the analysis and the shortcomings of the data.

To the extent that comparisons are warranted, the analysis indicates that large crop and livestock farms make heavier use of funds supplied by landlords and creditors than by farm operators. In contrast, dairy farms tend to make greater use of operator funds than of external sources of funds. Smaller farms appear to rely more heavily upon operator funds

[8] Eugene Clark, "Farmer Cooperatives and Economic Welfare," *Journal of Farm Economics,* 34:35-51, 1952.

and to some extent on local commercial banks and federal credit agencies. Insurance companies tend to finance large specialized types of farming under long-term commmitments. Commercial banks appear to make short-term investments, adjusting to prevailing local capital supply situations. Federal agencies seem to serve a cross section of all types of farms. Landlords, as equity investors, tend toward more risky ventures, while farm operators ordinarily furnish most of the farm capital where day-to-day management decisions are relatively important.

Horton states on page 16 that his findings "on the structure and operations of the agricultural sector of the capital market should contribute indirectly to the solution of a number of specific problems in the field of agricultural finance." This leaves us wondering just what problems his investigation is intended to help solve.

In this study, we are faced with a number of tabulations that form the basis of the analysis. The method of subclassification gives us no measure of how important the relationships are since averages by themselves give no indication of the closeness of correlation. If tests of significance were applied the presentation could be made with more confidence and numerous averages of dubious statistical validity could be discarded. Also, grouping of highly intercorrelated data, as for example economic indicators which are closely related to asset size, leads to spurious conclusions. Substituting county data for an individual farm ownership unit merely produces a statistic. The fact that counties within type-of-farming regions did not reflect common type characteristics (p. 34) should serve as a warning in the use of aggregate data. Horton appears to rely on compensating errors to correct estimates of value of farm physical assets not included in census reports. This procedure weakens the soundness of such data and lessens confidence in the findings. However, numerous recommendations are made for improving the quality, composition and availability of data to upgrade the statistical soundness of future macro-studies.

There may be some warrant for observing progressive stages of maturity of the investor as a claimant of farm assets. For example, a tenant operator may succeed in becoming a debtor owner-operator and later an unencumbered owner-operator. Over time he may mature into a landlord or become a creditor. Perhaps a more rewarding approach to the study of claimants is to examine the portfolios of various lenders to determine the kinds of farm assets they finance.

Risk and uncertainty in relation to use of borrowed funds were not considered in this study, although Horton devoted an earlier analysis of the same data to this aspect. (See "Adaptation of the Farm Capital Structure to Uncertainty," *Journal of Farm Economics*, Vol. XXXI, No. 1,

Part 1, February, 1949, pp. 76-100.) Perhaps this omission may help explain why the present study does not show significance in measuring the extent of creditor interests.

The use of terms needs some standardizing. For example, using "sectors of agriculture" and "agricultural secto·" in the same report leads to confusion. The interchangeable use of "financial organization of farms," "farm financial patterns," "financial structure of farms," and "capital structure of farms" is disturbing. Also, using "patterns of farm economic organization," "economic and physical features of farms," and "economic nature of agriculture" interchangeably is slightly confusing.

One may be at a loss to explain publishing a study that is now 12 years old and which draws upon data 17 years old. Between 1940 and 1950 the value of physical farm assets per farm in current prices nearly trebled and since 1950 has continued to rise. This might be dismissed lightly because there are no definite conclusions to be drawn from the study, perhaps since no definite problem was defined in the first place. We are led to conclude that Horton's principal contribution is to demonstrate the use of county-level data in a methodological innovation that "reflects" not "determines" relationships.

IRVING F. DAVIS, JR.

Colorado State University

The Business Side of Farming, D. M. Malloch and I. W. Weston. Christchurch, New Zealand: Whitcombe and Tombs Ltd., 1956. Pp. xi, 90. 13s 6d.

Guide to Farm Management, James Wyllie. London: Vinton and Company Ltd., 1956. Pp. 142. 12s 6d.

Farm management, according to Malloch and Weston (p. 71), can be divided into two parts:

"a. The *business* side, concerned with capital, land tenure, marketing, taxation, etc. This may be called the Economics of Farm Management.

b. The *functional* or *professional* side, concerned with production and all the prerequisites and activities of production. This may be called the art of organizing and managing a farm."

Using this division the New Zealand book emphasizes the business side, while the British book deals primarily with the functional aspect.

Malloch and Weston give an informative description of the land-use and tenure systems in New Zealand as well as an appraisal of the current prospects for beginning farmers. Of special interest in a section on farm tenure is a discussion of the private limited-liability company as a form of farm ownership. An excellent chapter on purchasing a farm gives a procedure for budgeting expected income as a basis for estimating pur-

chase price. In contrast to the United States, under the Torrens System of registration of land transfer titles, the validity of the title is guaranteed by the state. A particular title can be searched by payment of only two shillings.

The final two chapters are the ones promised by Colin Clark in the foreword (p. ix) to include some of the basic principles of economics. The chapter on prices and marketing includes a short discussion of price cycles and their relation to success in farming. The final chapter, "Reference to the Social Sciences," turns out to be mostly devoted to a plea for commodity-based money. "The general adoption of a commodity money would greatly assist automatic injection of money into the economic system on the buying side of industry, encourage international cooperation, and decrease monetary causes of international friction" (p. 81). The somewhat unbalanced treatment of the role of social sciences (history, politics, ethics, logic, and economics) prevents this chapter from developing a frame of reference for analysis by the student. It would perhaps have been better to have developed the economic principles in this concluding chapter in more detail and placed them nearer the beginning of the book.

It would be much easier to find an American counterpart for *Guide to Farm Management* than for *The Business Side of Farming*. The British book is written from a broad base of first-hand experience on the part of the author. From this experience the author has distilled some rather general principles. ". . . some of the basic principles which are generally found in action on successful farms: a strong accent on pushing up the total farm output, the making of the total farm profit the final test of the economy of any changes in organization and management which may be made, the proper definition of cost reduction, a reduction in the cost per unit of product, the need for adaptability and flexibility in the management, thorough, timely cultivations and constant attention to details in carrying out the day-to-day work on the farm" (p. 39).

After a general discussion of the importance of technical knowledge, we find chapters on the selection of a system of farming and getting a farm. Discussions of management problems of four livestock enterprises are presented in separate chapters after some general considerations of farm planning. A chapter on crop production following the livestock discussion is an interesting, though understandable, inversion of the usual approach in the corn belt. There is an important theme that runs through this well-organized book: The farm should be viewed as a unit. The inclusion of cost-of-production analysis in the discussion of each of the enterprises seems to run counter to this central notion of "whole farm." No mention is made of the interpretation of these cost data in terms of their adjustment to reflect on-farm opportunity costs. It should be pointed

out, however, that the author senses keenly the limitations of farm cost data. For example in relation to milk production he says, "A detailed statement of milk production costs, returns and profits never does more than pin-point the *results* of a particular way of running a particular herd: it gives nothing but indications, hints or clues about the *causes* of the results" (p. 80). Since this book was written primarily for students in farm institutes, a section on more specific procedures for both total and partial budgeting might have been a useful addition.

EARL R. SWANSON

University of Illinois

The Australian Wheat-Growing Industry 1788-1948, Edgars Dunsdorfs. New York: Cambridge University Press, 1957. Pp. xi, 547. $10.00.

Credit is due the author for a painstaking effort in describing and analyzing the wheat industry of Australia. The book is divided into two parts. Part I is primarily a descriptive treatise of development of the wheat industry from colonization of Australia to the present time. However, the author weaves numerous interpretations throughout this section. From a historical standpoint this is a very comprehensive and detailed account of the development of the wheat industry. Possibly it is too detailed for the average reader.

Part II is primarily devoted to analysis of factors that have fashioned development of the wheat industry—with the expressed objective of facilitating formulation of current economic policy. Statistical verification is limited almost exclusively to regression techniques. In many respects this is reminiscent of an earlier period in American agricultural economic history.

One of the most interesting relationships developed was producers' response to prices. With both prices and acreage expressed in terms of trend, it was determined that prices below the trend resulted in an expansion in the area under wheat and that prices above the trend had a similar, though less vigorous, effect. This relationship held whether the trend was rising, stagnating or declining. The author went to considerable length in analyzing the cost of producing wheat. This is an important consideration, in as much as guaranteed prices for domestically utilized wheat are based on the cost of production. Yield and scale of operation were established as the major factors influencing unit costs. From this and other considerations it was concluded that variability of yield was a major disturbing factor in the wheat industry. Policy recommendations in this regard were for abandonment of wheat production in marginal areas and expanded effort to increase average yields in areas classified as suitable for wheat production. In somewhat guarded terms it was indicated that

competitive (or free market) prices, if permitted, would provide an effective mechanism both for weeding out inefficient wheat producers and stimulating an increase in yield.

Depopulation of wheat areas, was determined to be the result of increased efficiency and inadequacy of income. The latter was viewed with concern and policy recommendations in this regard departed from economic criteria. The author held that development of a genuine Australian national culture necessitated maintenance of the agricultural population. In the view of many professional economists the author might be critized for injecting personal value judgment in this recommendation rather than framing it in such a way that the burden of decision would be left to Australian society.

In the opinion of the reviewer a major weakness of the analysis is inadequate treatment of income consequences in the event that competitive prices were allowed to perform the function of weeding out marginal producers. Guaranteed prices were cited as a handicap to incentive in obtaining higher yields and in reducing costs. However, conclusions regarding the subsequent economic position of wheat producers seemed to imply no change in the price structure. A rigorous analysis of the demand for wheat, through development of coefficients of price elasticity, would have strengthened the over-all study.

Concern with details makes the book somewhat tedious to read. However, this is alleviated for the casual reader by a summary appended to each chapter. There is no doubt that the book accomplished in a creditable manner a stated objective of contributing to the study and understanding of the economic history of Australia. The author has provided a valuable service in formulation of current economic policy for the Australian wheat industry.

JOHN H. MCCOY

Kansas State College

Boxcar in the Sand, Laurence Hewes. New York: Alfred A. Knopf, 1957, Pp. vii, 262. $4.75.

This is a most interesting book. I can unhesitatingly recommend it as worth reading. It is a refreshingly frank, delightfully written, reasonably accurate account of one New Dealer's experience in agriculture and related federal programs over the past 25 years.

On the jacket, Henry A. Wallace describes Larry Hewes as a "minor administrator." In the sense that he was never in the Cabinet, nor in the little Cabinet, nor a bureau chief, nor even a major controversial figure of lower bureaucratic rank, Hewes was a minor official; but in the sense of men who translated into action the ideas and dreams of the top officials

and architects of the New Deal, men like Hewes were far from minor. Although his career is possibly not fully typical, his experiences are at least illustrative of an important type of individual who was most significant during the 1930's and early 1940's.

After an educational experience that clearly fitted him for no productive activity—in part because he himself did not know what he was seeking—and after various private employments that brought income but not satisfaction, Hewes drifted into public employment in a land bank, largely because this was the only job he could find. Brought up against the stark poverty and hopelessness of the severe depression years, his conscience and his mind slowly awoke. His big opportunity came with a job in Washington, as a personal assistant to the then Administrator of the Resettlement Administration and Undersecretary of Agriculture, Rexford Tugwell. His admiration and even worship of this chief shows through clearly, now more than 20 years later. Hewes was literally a bureaucratic babe in the woods, and his errors and naïveté, amusingly and frankly recounted, seem almost unbelievable in this day when sophisticated bureaucrats are easily employed. But it was not so then, when the whole range and content of federal agricultural programs was in revolution.

From Washington, Hewes went to San Francisco as a regional administrator of what was by then the Farm Security Administration. His experiences in rural rehabilitation and resettlement formed a prelude to an extremely difficult and trying time in the administration of the farm lands owned by the newly evacuated Japanese-Americans, victims of a war resentment and of a stubborn military bureaucracy. From this, he was plunged into the farm labor recruitment program in Mexico. He made friends with the Mexicans and made deep enemies of the larger agricultural employers of California and the West, who already looked upon him with suspicion. Feeling that his usefulness was ended there, he left and shortly got into work in race relations along the Pacific Coast. And from this he went to the land reform program of Japan, where he worked for two years as one of the chief architects of that program. (That program has been written up by Hewes in *Japan—Land and Men. An account of the Japanese Land Reform Program 1945-51*[1] published by Iowa State College Press, and in *Japanese Land Reform Program*, SCAP, GHQ, NRS Report No. 127, Tokyo, 1950.)

Hewes has clearly made an attempt to describe his experiences, and the various programs with which he was associated, in as accurate and objective terms as possible. Others, connected with those programs, would

[1] Reviewed by William W. Lockwood, *Journal of Farm Economics*, Vol. XXXVIII, Aug. 1956, pp., 885-7.

undoubtedly describe the same situations differently. But, on the whole, his account seems reasonably accurate to this reviewer. One senses that his treatment of persons still living is more restrained than that of some who have died. The scant mention of that colorful figure, General Douglas MacArthur, in the two chapters devoted to Hewes' Japanese experience, must surely conceal some interesting experiences.

When Hewes entered the federal agricultural programs, he was uninformed, not to say illiterate, on any technical aspect of agriculture or economics. He makes this clear. He worked hard, including heavy reading and evening classes, to obtain a reasonably good professional competence and an advanced degree. Today he is a recognized craftsman in his professional field, and holds a job as an agricultural specialist with the Bureau of Reclamation in Denver. One cannot but give praise for this somewhat delayed flowering of professional competence and achievement.

But there is another side to it also. When Hewes entered government, he brought to it a high enthusiasm, great ideals, and a drive and energy that was not untypical for the time. This enthusiasm and these ideals lacked form in many cases—one of my old friends has described some of these people as blobs of liberal protoplasm. But it had a quality that has all too often been gradually lost and that is all too often lacking in federal service today. In fact, I would not know where the Hewes of 1935 could find a job with the federal government today where his enthusiasm and ideals would compensate for his lack of experience.

MARION CLAWSON

Resources for the Future
Washington, D.C.

Location and the Space-Economy, Walter Isard. Cambridge and New York, Massachusetts Institute of Technology Press jointly with John Wiley and Sons, Inc., 1956, Pp. xix, 350. $8.75.

Here is probably the most comprehensive treatment to date of the factors determining the locational equilibrium of the individual firm. Moreover, the book not only effectively consolidates earlier works, but also, as its major contribution, fits the theory into a factor substitution framework at least analogous to if not directly integrable into general production theory.

The first four chapters of the book provide an introduction, a summarization of earlier work, some empirical evidence of systematic locational variation and a conceptualization of the theoretical problems of handling distance inputs. Chapter 9 attempts to fit the theory developed in the earlier chapters into traditional international trade theory and the last two chapters summarize the argument mathematically and graphically, respectively.

The heart of the analysis is to be found in Chapters 5-8 which take up in order; (1) location under simple transport-cost minimization, (2) location with spatial variation in particular production costs, (3) location with areal rather than point markets, (4) location considering economies of urban agglomeration. Much of the theory is a restatement of traditional Weberian analysis in terms of substitution analysis. In addition, however, the Weberian case is generalized further by way of considering realistic transport-rate schedules directly in the analysis instead of by means of cumbersome "ideal weights." Although this attempt at greater reality is admirable, it might seem that a rather large amount of space has been given to what is probably the least interesting relaxation, conceptually.

The analysis does take up directly the much more vital considerations of multi-point markets and alternative raw material sources. However, the analysis is confined to a determination of equilibrium where either (1) many markets are served by a production process that uses any number of single-source raw materials, or (2) a single market is served by a production process that uses raw materials each available from any number of alternative sources. It does not, however, even in the mathematical restatement in Chapter 10, consider the nature of locational equilibrium when both conditions prevail simultaneously. Considerable complications in kind as well as in degree may result in such a situation.[1]

The very difficult problem of handling multiple markets and multiple raw material sources simultaneously is not explicitly solved. This, however, can hardly be raised as a serious criticism of a work that has truly made as much of a theoretical advance as might be expected from a first effort. Still, it would have been quite helpful to the reader if there were included at least a discussion of where this and other difficult problems fit into the total conceptual framework. This is also at least partly true of the case of producers in noncompetitive markets. Such firms are given only token mention in the introductory section of Chapter 5 and a fairly cursory examination in Section 3 of Chapter 7.

The theory developed in the course of the book is much more an explanatory one than a predictive one and this is much more due to the complexity of the world than to inadequacies of the analysis. Where the author is considering anything more than the simple case of substituting among different kinds of transport inputs he states, "That here the choice of the optimum location requires an outright comparison of outlays on the various kinds of labor, or of total labor outlays and total transport

[1] See Tjalling Koopmans and Martin Beckman, "Assignment Problems and the Location of Economic Activities," *Econometrica*, Vol, XXV, pp. 53-76. This was not published until after the book being reviewed here, so no citation of it will be found in Isard's work.

outlays, or of total labor outlays and total interest outlays, and so forth . . ." (p. 36). In many other places too the theory is very Chamberlainian in its absence of any path to equilibrium.

In fairness to readers of this *Journal* it should be pointed out that the treatment of agriculture is somewhat less extensive than indicated by the table of contents. It is largely confined to an admirable restatement of the Thünen "concentric-ring" theory of agricultural land use in terms of a substitution framework and a demonstration of how this theory can be built up from considering the locational equilibrium of the individual farm. Although this leads to a successful integration of the theories of location of farms and factories, it does so only at a fairly general level of abstraction. Moreover, the specific applications of land-use analysis are confined to urban examples.

Although much of the book consists of material previously published in the journals by Professor Isard, its direct inclusion does not seem seriously to affect the exposition and orderly development. In spots, however, the material might be found difficult for some. For specialists in regional economics, however, the book should be both readily understandable and essential material in its entirety. In addition, Chapters 1, 2, 4, and 11 would provide valuable readings for even elementary students interested in some exposure to location theory. Chapter 2 is especially valuable in providing a concise summary of a number of works not available directly in English.

CHARLES L. LEVEN

Northwestern University

Principles and Problems of Modern Economics, William A. Koivisto. New York: John Wiley and Sons, Inc., 1957. Pp. xxi, 834. $6.00.

This textbook for the elementary course in economics is designed to be used, "depending on one's value judgements: either as a problems course designed to instill a thorough knowledge of principles or, alternatively, as a theory course intended to illuminate current problems" (preface, p. v). Integration of principles and problems or problems and theories is accomplished by dividing the main portion of the book into three parts: "The Problem of Economic Instability," "The Problem of Economic Inefficiency," and "The Problems of Economic Inequality." In addition, the introduction provides a section on "Background and Orientation" and the conclusion offers "The Reconciliation of Conflicting Optima."

The development of each of the three problem sections is roughly similar. The reader is introduced to the general problem area—e.g. the discussion of economic instability opens with a description of business cycles—then leads to a discussion of the role of the consumer, the develop-

ment of a theoretical framework for analysis, a description of institutional characteristics and to an application of the theory to specific problem areas such as foreign trade, full employment, monopoly, and wage determination. Stating the organization of each section in the above manner is an oversimplification because Koivisto does, on occasion, shift the order of development or combine topics in a manner that lends clarity to the presentation and demonstrates the way in which various economic phenomena are interdependent.

The development of theoretical concepts is orthodox. Problems of economic instability are explained by Keynesian national income analysis modified by exogenous shocks of Schumpeterian innovations. Problems of economic inefficiency and economic inequality are analyzed within the framework of indifference theory and marginal analysis including most of its permutations. The importance of "consumer sovereignty" as the keystone of these theoretical models is emphasized by the author. This serves both to unify the analysis of the three problem areas and to demonstrate clearly to beginning students how orthodox analysis depends on unrestrained maximizing behavior by consumers.

The material presented in the book is difficult and will require intensive study by most freshman or sophomore students. The author obviously is attempting to maintain a high standard of academic achievement despite the pressures exerted by the shifting to the right of the demand curve for a college degree (as differentiated from the demand for a college education). The book is well written, extensive use is made of examples and graphs, and, in most instances, development of theoretical concepts is complete; but, the analysis is extended to deal with problems of a fairly high order of complexity. Students using the book will be expected to become proficient enough in the manipulation of orthodox theoretical constructs so they can comprehend balanced budget multipliers, factor returns under monopsony, and international trade transformation curves. Understanding materials included in this text will give majors an excellent preparation for more advanced courses and perhaps even convince other students that solutions to economic problems require something more than a puerile declaration of faith in the "law of supply and demand."

As an introduction to the techniques of macro- and micro-analysis and the application of these analyses to economic problems, the book is good. There are, however, certain defects or omissions. At least three of these appear to be important enough to warrant some discussion.

A definite weakness of the three sections is the failure to present explicitly the assumptions made in constructing theoretical models. When theoretical constructs are presented as "problem-solving" or "illuminating"

devices, it is of the utmost importance that students be made aware of the limitations imposed on the applicability of the analysis by the assumptions that determine the logical deductions. In spite of the length of this book, the small amount of additional space needed to present in detail assumptions of the analyses would have been amply justified.

It is difficult to quarrel with the idea of including material on the development of economic thought and on its relation to economic history in an elementary text. Koivisto makes an attempt, in one brief chapter, to cover the topic. But in the allotted space, he can only present a part of the subject's skeleton without any of the meat or connective tissue. Some of the most important names in economics are mentioned and part of their work related to economic issues of their time, but their contributions to the field are sparsely treated. The importance of the contributions of various economists is, of course, a matter of judgment, but devoting space to John Stuart Mill as "the foremost serious economist of the middle of the nineteenth century" (p. 39) and ignoring the contributions of the Germans and Austrians is questionable. This is particularly true because of the close relation between these economists and much of the theory developed in two of the problem sections. It is also gratuitous to dismiss Marx as "not regarded as a respectable economist in his own day, but rather as an agitator making class appeals" whose "extreme views on the future of capitalism were not taken seriously" (p. 39). In fairness to the author it must be emphasized that, with the exceptions noted above, a better review of economic thought probably could not be presented *in the allotted space.*

Agricultural economists will probably be most intrigued by the concluding section of the book. This is a chapter on reducing conflicts in economic goals and is mostly devoted to "the agricultural problem." The farm problem is said "to consist of inequality between farming and the rest of the economy, and instability within agriculture" (p. 802). The usual causes of this problem—the monopolists and monopsonists with which competitive farmers must deal, inability to adjust to price changes rapidly, the inelastic demand for most farm products, an excess number of producers in agriculture, etc.—are described and the author passes on to possible solutions. It is here that he is hoisted on his own petard. The nearly four hundred pages that have been devoted to establishing the competitive system as the ideal of efficiency and allocation of resources cannot be ignored. Only vague suggestions about inducements to move individuals out of agriculture are offered as solutions to the problem of income inequality. But some of this inequality is due to inefficiency and this leads inexorably to instability of prices and to misallocation of resources. Here the oil of forward prices may be poured on waters stirred

up by the winds of inefficiency and price instabilities. Farmers may then sail the calm waters of the perfectly competitive sea propelled by stable prices to the snug harbor of efficiently allocated resources. Many, I fear, will question the efficacy of this solution to the farm problem.

There are other aspects of this text that may be questioned; but they seem to be of less importance to this reviewer than those discussed above. These include the use of the tangency solution in the discussion of monopolistic competition, the discussion of equivalent variation, the apparent confusion between scale and size, the use of community indifference curves, and labeling of marginal factor-cost curves as MC in the discussion of monopsony. In addition, the problems of economic growth are given less than adequate coverage, but this is unquestionably more a defect of the discipline than of the author.

This book is good within the limits imposed by the author. Orthodox techniques are thoroughly developed and extended to an analysis of complex problems. Instructors who believe that students in their first course should be introduced to most of the extensions of supply-demand analysis into areas of international trade, public finance, monopoly-monopsony, etc., will find this book superior to many others in this field. Teachers wishing to emphasize economic history, development of economic thought, economic organization and problems of growth rather than the more intricate extensions of orthodox theory, however, must look elsewhere for a text.

EDWARD B. HOGAN

University of Rhode Island

NEWS NOTES

BEN F. ALVORD has transferred from the Department of Agricultural Economics to the administrative staff of the Alabama Agricultural Experiment Station at Alabama Polytechnic Institute. He will continue to serve as Professor of Agricultural Economics at A.P.I.

RAYMOND BAILEY, Ohio State University, completed his Ph.D. degree in June and has been appointed Assistant Professor in the Department of Agricultural Economics at that institution.

GEORGE BAKER has joined the staff at Purdue University as specialist in retail food merchandising.

FRANK D. BARLOW, JR., formerly with Foreign Agricultural Service, has joined the Market Development Branch of the Marketing Research Division, AMS, and will be located at the Branch's New Orleans, Louisiana Office where he will be in charge of cooperative research with the Southern Utilization Research and Development Division, ARS.

R. O. BAUSMAN retired as Head of the Department of Agricultural Economics at the University of Delaware on July 1 to accept an appointment with the Land and Water Section, Agricultural Research Service, United States Department of Agriculture.

SHERWOOD O. BERG joined the staff of the University of Minnesota in July as Professor and Head of the Department of Agricultural Economics. Dr. Berg has been serving as Agricultural Attache in Denmark.

JOHN D. BLACK has returned to Harvard University after spending several months at the headquarters of the Economic Commission for Latin America in Santiago, Chile.

ALBERT R. BLANCH has joined the Utah staff of the Farm Economics Research Division, ARS, transferring from the Forest Service regional office at Ogden, Utah.

K. D. BLOOD retired from the Oklahoma office of the Agricultural Estimates Division, Agricultural Statistician in Charge, on April 30, 1957. He had 37 years of federal service. Donald Pittman will succeed Mr. Blood as Chief Agricultural Statistician in Charge of the Oklahoma office.

L. L. BOGER was part of a small group visiting Pakistan and countries en route July 1 to August 15. This group is implementing plans and procedures with respect to a recent contract between the Ford Foundation, Government of Pakistan and Michigan State University to establish two college level institutions to train workers in the Village Agricultural and Industrial Development Program.

WILLIAM BOLTON is now a member of the staff of the Farm Economics Research Division, ARS, stationed at Baton Rouge. He will conduct research on problems of low-income farms.

ALBERT P. BRODELL has retired from the staff of the Farm Economics Research Division, ARS, after almost 37 years service in the Department of Agriculture, most of it in the farm management field.

EARL BROWN has been appointed Instructor in Agricultural Economics at Michigan State University. Recently completing his M.S. degree at the University of Minnesota, he will do work in retailer education and work towards the Ph.D. at Michigan State.

EARL L. BUTZ became Dean and Director, School of Agriculture, Agricultural Experiment Station and Extension Service at Purdue University on August 1. For the past three years he has been Assistant Secretary of Agriculture, on leave from the Department of Agricultural Economics at Purdue. Lowell Hardin succeeded Dr. Butz as Head of the Department of Agricultural Economics.

EUGENE CARTER transferred from the Fruit and Vegetable Statistics Branch, Agricultural Estimates Division, AMS, to the Agricultural Statistician's Office in Idaho on May 19, 1957.

RAYMOND P. CHRISTENSEN, Farm Economics Research Division, ARS, spent the months from September through December in Argentina as a farm management specialist for FAO.

WAVERLY CHUMNEY recently joined the staff of the Farm Economics Research Division, ARS, at Raleigh, where he will work on a study of cotton production practices and costs in the coastal plain of North Carolina.

FRED COLE has been granted a sabbatic leave by the University of Massachusetts beginning July 15. He will make a study of terminal fruit and vegetable markets in the United States.

CLIFTON B. COX, Purdue University, was one of a party of three who spent the month of July studying swine production, marketing and processing methods in Western Europe and the Scandinavian countries. The study was made under the sponsorship of the Producers' Swine Improvement Association.

REX W. COX retired on June 30 from his position as Associate Professor of Agricultural Economics at the University of Minnesota. He has been there for 29 years. He moves to Brookings, South Dakota where he will teach at South Dakota State College.

WILLIAM CROMARTY has been appointed Assistant Professor at Michigan State University. He recently completed his Ph.D. at the same institution.

RICHARD DARLEY will join the staff at Purdue University September 1 as research and extension s, ecialist in poultry .narketing.

LAWRENCE B. DARRAH of Cornell University is visiting Professor at the College of Agriculture, University of the Philippines, where he is helping to develop a program in marketing.

LYNN H. DAVIS, Associate Professor of Agricultural Economics, has been awarded the Robert Johnson Fellowship at Oregon State College where he will begin work on his Doctor of Philosophy degree September 1.

PETER DORNER, formerly of the Agricultural Economics Department of the University of Wisconsin, is joining the teaching staff at Harvard University for the year 1957-58.

EDWIN E. DREWNIAK has joined the staff of the Poultry Branch of Farmer Cooperative Service as Marketing Specialist. He holds B.S. and M.S. degrees from the University of Massachusetts in chemistry and food engineering. Prior to his present position he worked on problems of food technology with Agricultural Marketing Service and C. A. Swanson & Sons, Omaha, Nebraska.

WENDELL G. EARLE of Cornell University is spending his sabbatic leave at the University of Wisconsin undertaking a study of the marketing extension programs of several states under the sponsorship of the National Agricultural Center for Advanced Study.

HAROLD ECKER has accepted the position of Instructor in the area of agricultural policy on the research and teaching staff at Ohio State University.

GEORGE C. EDLER, who retired from the Agricultural Estimates Division, AMS, received the Length-of-Service Award for 40 years of USDA service on May 21, 1957.

ALVIN EGBERT has joined the staff of the Farm Economics Research Branch, ARS. He is stationed at Ames, where he is doing exploratory work on levels of production required in various regions in order to assure optimum use of resources in agriculture.

ROBERT V. ENOCHIAN will be located in the Albany, California office of the Market Development Branch of the Marketing Research Division, AMS, where he will be in charge of cooperative research with the Western Utilization Research and Development Division, ARS.

CLARK FERRIES has completed his M.S. degree in Agricultural Economics at Oregon State College and has accepted a position with the Canada Department of Agriculture at Ottawa.

R. M. FINLEY, who received his Ph.D. degree from the University of Illinois in June, joined the Department of Agricultural Economics, University of Nebraska, on August 1. He will teach and conduct research in production economics.

JOHN FOSTER was appointed Assistant Professor of Farm Management at the University of Massachusetts, February 1, 1957.

ROBERT L. GLOVER, who recently received his M.S. degree from Alabama Polytechnic Institute, has joined the Agricultural Economics staff at A.P.I. on a temporary basis as Assistant in Agricultural Economics.

JOHN HAGGERTY, who at one time was a member of the land economics staff of the former Bureau of Agricultural Economics, was recently sworn in as International Cooperation Administration Director in Israel. For the last two years, he has been in Paris on an assignment for the State Department.

JAMES B. HASSLER, formerly Assistant Agricultural Economist and Lecturer at the University of California at Berkeley, is joining the staff of the Agricultural Economics Department, University of Nebraska, as an Associate Professor on July 1. He will teach and do research in the area of marketing and price analysis.

TYLER HAYGOOD, Farm Economics Research Branch, ARS, who has headed the work on farm taxation and local government for a number of years, has retired because of physical disability. He expects to live on a family farm near Champaign, Illinois.

PETER L. HENDERSON has recently joined the staff of the Market Development Branch of the Marketing Research Division, AMS.

T. A. HIERONYMUS visited Northern Europe during the summer months for the Foreign Agricultural Service, United States Department of Agriculture, to study the market for protein concentrates.

JIMMYE HILLMAN, who is completing two years with the United States of America Operations Mission to Brazil, Institute of Inter-American Affairs, with headquarters at Rio de Janeiro, returns September 1 to resume his position as Associate Professor in the Department of Agricultural Economics, University of Arizona.

J. A. HODGES was on leave from Kansas State College from April through July. He served as leader for a group of farmers from India who were studying some organizations and group activities of the farmers in Kansas, Indiana, California, Mexico, and Illinois.

WILLIAM S. HOOFNAGLE, formerly with the Merchandising Methods Section of the Market Development Branch, Marketing Research Division, AMS, has been made Head of the Distribution Programs Research Section of that Branch.

JACK P. HUDSON joined the staff of the Department of Agricultural Economics and Farm Management, University of Manitoba, as Research Associate. Mr. Hudson will be directly involved in a research project dealing with farm business planning in co-operation with the Carman District Farm Business Association.

HARALD R. JENSEN joined the staff at Purdue University on June 15, 1957, as Associate Professor in production economics and farm management.

OSCAR B. JESNESS retired from the position of Professor and Head of the Department of Agricultural Economics, University of Minnesota on June 30.

He has served in that post for almost 30 years. He will continue to live in St. Paul and take care of varied interests.

CLAIRE F. JONES has resigned as Assistant in Agricultural Economics at the Alabama Polytechnic Institute. For several years she has been on a full-time research appointment working in the areas of consumer economics and marketing of dairy products.

ETHEL JONES joins the staff of the Department of Economics and Sociology at Iowa State College on September 1 to participate in a consumer information project. The purpose of the project, which is conducted under contract with the Federal Extension Service, is to develop materials for use by extension workers in the Marketing Information for Consumers program. Miss Jones received her B.A. degree in economics from Vassar College and her M.A. from the University of Chicago, where she is completing her doctoral work.

THOMAS M. KNAPP formerly from the Agricultural Statistician's Office in New York Agricultural Estimates Division, AMS, has transferred to the Fruit and Vegetable Statistics Branch of the Agricultural Estimates Division in Washington, D.C.

ORVILLE E. KRAUSE of the Wisconsin Crop Reporting Office has just completed the work for his Ph.D. in Agricultural Economics at Wisconsin. His thesis, "Wisconsin Feeder Pig, Markets and Prices," is the outgrowth of more than four years of research. The Crop Reporting Office is publishing a bulletin based on this study.

LEONARD KYLE left in August for Palmira, Colombia for a two-year assignment under the cooperative contract between Colombia, ICA and Michigan State University. He will continue and expand the farm management work started by Gerald Trant.

W. GRANT LEE of the Agricultural Statistician's Office in Idaho transferred to the Agricultural Statistician's Office in Colorado of the Agricultural Estimates Division, AMS.

HAROLD LOVE has resigned as Farm Management Specialist to accept a position of Professor of Agricultural Economics at the University of Houston.

GABRIEL LUNDY, Head of the Agricultural Economics Department at South Dakota State College from 1934 to 1950, retired July 1 after 41 years of service.

EDWARD A. LUTZ of Cornell University left in June to spend a year or more at the College of Agriculture, University of Philippines. He is under the direct sponsorship of the Council on Economic and Cultural Affairs. He will be primarily concerned with research, extension and teaching in local government.

WILLIS W. MARSHALL, who recently received his M.S. degree from Alabama Polytechnic Institute, has joined the Agricultural Economics staff at A.P.I.

as Assistant Agricultural Economist. He will do research in connection with marketing tests and consumer acceptance of newly developed horticultural products.

JAMES R. MARTIN joined the Texas staff of the Farm Economics Research Division, ARS. Mr. Martin received his M.S. in May from the Texas A & M College.

WILLIAM E. MCDANIEL became Head of the Department of Agricultural Economics at the University of Delaware on July 1, succeeding R. O. Bausman. Dr. McDaniel has been a member of the Department of Agricultural Economics, University of Delaware since 1951.

LESLIE DONALD MCMULLIN joined the Marketing Division of the Farmer Cooperative Service. He was formerly with the Market Development Branch of the Agricultural Marketing Service. In his new assignment he will be working on problems of peanut grower marketing organizations.

PAUL O. MOHN, Extension Marketing Specialist from Oregon State College, reported for duty with the Division of Agricultural Economics Programs, Federal Extension Service, on June 25. Mr. Mohn is assigned to marketing extension leadership in the General Crops Marketing and Utilization Branch. He is a graduate of Kansas State College; his M.S. degree was obtained at Mississippi, and he is a Ph.D. candidate at Oregon.

FLORENCE E. MOORE transferred to the Agricultural Price Statistics Branch in Washington, D.C. Agricultural Estimates Division, AMS, from the Oregon Office on May 19, 1957.

JOE MOTHERAL, Farm Economics Research Division, ARS, recently spent two months in Iran on an assignment to provide advisory service on land distribution and related problems. While there he had a conference with the Shah on the land-distribution program.

ROBERT D. MUNSON joined the Agricultural Economics Branch of TVA on March 25, 1957 as an agricultural economist. The main emphasis of his work will be in the agronomic-economic research activities.

MAX MYERS has been named Director of the Agricultural Experiment Station at South Dakota State College. He was formerly Head of the Economics Department.

RALPH NELSON has been appointed Assistant Professor of Economics at South Dakota State College. He was formerly engaged in research in agricultural and industrial development for the Great Northern Railway.

NIELS I. NIELSEN was appointed to succeed G. A. Scott, retired on October 31, 1956, as Agricultural Statistician in Charge of the California office of the Agricultural Estimates Division, AMS.

FRANK OVERLEY joined the staff at the University of Connecticut on February

15, 1957 as Extension Economist in Farm Management. He received his M.S. degree in agricultural economics at Michigan State University in January 1957 and was formerly employed as Assistant County Agent in Brown County, Kansas, where he worked with the balanced farming program.

Ross L. Packard, who has been employed in the Wisconsin Crop Reporting Office since 1950, transferred to the Ohio Crop Reporting Office late in 1956. He completed his Ph.D. at Wisconsin jointly between Agronomy and Agricultural Economics last October.

Elmer J. Perdue has been employed by the Cotton and Oilseeds Branch of Farmer Cooperative Service. He is completing the thesis requirement for the M.S. degree in Agricultural Economics at Oklahoma A & M College.

Frank Robotka, Department of Economics and Sociology, Iowa State College, will present a paper on "The Value of Theory in Cooperative Research and Education" at the International Meeting on Cooperative Science to be held in Erlangen, Germany, August 20-25, sponsored jointly by five German and Austrian universities. He will also attend the annual Congress of the International Cooperative Alliance at Stockholm, August 4-8. He will spend about three weeks studying developments in cooperative research and education and problems of cooperatives in Northern European countries.

Leroy Rude recently joined the staff of the Farm Economics Research Division, ARS, at North Dakota, where he will work on the Great Plains survey.

Job K. Savage, Jr. has been appointed to the position of Chief of the Special Crops Branch of Farmer Cooperative Service, to succeed Henry M. Bain, who retired March 1, 1957.

Mervin G. Smith, Chairman, Department of Agricultural Economics and Rural Sociology, Ohio State University, has been in South and Central America during the summer aiding in developing teaching programs in the field of agricultural finance in several South American universities.

Limen Smythe, Professor of Economics, is serving as Acting Head of the Economics Department at South Dakota State College.

James Snyder recently joined the staff at Purdue University as Instructor in Business Management. He will teach and do research in the expanded Purdue curriculum in Agricultural Business Management.

Harry A. Steele, Farm Economics Research Division, ARS, at the request of Assistant Secretary Ervin L. Peterson, is studying the problems raised for Clemson College by the Corps of Engineers' proposal to build a dam on the Savannah River at Hartwell. Large areas of Clemson College lands would be subject to flooding by the reservoir if the dam were built. Elmer Starch is a consultant on the study.

JAMES STEVENSON recently joined the staff at Purdue University as specialist in consumer marketing.

FREDERICK STOCKER has rejoined the staff of the Farm Economics Research Division, ARS, to take the place of Tyler F. Haygood, retired, as head of the work on farm taxation and local government.

GERALD TRANT returned June 15 from a two-year assignment as agricultural economist at Palmira, Colombia, under Michigan State University's technical assistance contract. Part of his work involved a demonstration of a modern fertilizer experiment, along with other work in farm management.

JACK L. TURNER has resigned as Assistant Agricultural Economist from the Department of Agricultural Economics at Alabama Polytechnic Institute to accept employment in the Department of Horticulture at the same institution. Turner has been engaged in research work in the marketing of new horticultural products at the Alabama Agricultural Experiment Station.

NORMAN ULASKER has joined the staff of the Farm Economics Research Division, ARS. He is stationed at Stillwater, where he will work on a cooperative study of low-production farms in eastern Oklahoma.

M. L. UPCHURCH, Farm Economics Research Division, ARS, recently spent a brief period in Hawaii, at the request of the Territorial Agricultural Experiment Station, to discuss research work in production economics with staff personnel.

VERN VANDEMARK, who completed his M.S. degree at Michigan State University, has accepted the position of Instructor in the area of food merchandising extension at Ohio State University.

L. T. WALLACE, formerly extension specialist at Nevada, joined the Purdue staff July 1 as specialist in rural development with particular emphasis on industrialization.

RICHARD J. WALSH has joined the Wisconsin staff of the Farm Economics Research Division, ARS. Mr. Walsh comes from the University of Nebraska, where he was a Research Assistant in the Department of Agricultural Economics.

HARVEY WARRICK has completed his M.S. degree in Agricultural Economics at Oregon State College and has returned to his home in Greenville, Ohio where he will operate the family farm.

PETER DALE WEBER, who has been employed in the Wisconsin Crop Reporting Office since 1953 and received an M.S. degree in Agricultural Economics in 1956, has been transferred to the Chicago Dairy Office of the Agricultural Marketing Service.

GARLAND P. WOOD has been appointed Assistant Professor at Michigan State

University. Recently on the staff at the University of Nevada with a Ph.D. from Wisconsin, he will do extension work in public policy.

MALCOLM E. WOOD has been appointed Instructor in Agricultural Economics at Michigan State University to do work in retailer education. He recently completed an M.B.A. at Indiana University.

Under contract with ICA Michigan State University is sponsoring a special general Agricultural Economics Training Course which will operate May 30 to September 13, 1957. While at Michigan State Professors Dean McKee, James Shaffer, Orion Ulrey, Karl Wright and Lawrence Witt will work with the visitors. They will also visit Purdue University, University of Tennessee, the annual AFEA meetings at North Carolina and the U. S. Department of Agriculture. Included in the group are visitors from British Guiana, Chile (2), Honduras, Indonesia, Iran, Pakistan (8), Philippines (3), Taiwan (2), and Thailand.

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TENTH INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS

The tenth International Conference of Agricultural Economists will be held in India from approximately August 23 to September 2, 1958. Specific dates and place of the meeting will be announced late in 1957 as details of the plans are still in the making. The general theme will be "Agriculture and Its Terms of Trade,"—a consideration of the problems of balance between agriculture and other activities in the process of the economic growth of states and the development of a sound world economy. Within the framework of the program some attention will be given to education, research and extension including the application of research in policy making.

Plans will include tours probably preceding and following the Conference in India and possibly at some point in Europe if there is a demand. Details concerning tours and program will also be available at a later date. The Finance Committee is making plans to grant travel fellowships to a limited number of delegates from the United States and other countries. Probably the grants will cover not less than half of the necessary expense to attend the Conference.

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Applications for membership, changes in address, or inquiries regarding the general affairs of the Association should be addressed to Lowell S. Hardin, Agricultural Hall Annex, Purdue University, Lafayette, Indiana.

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